National Weather Service
Upper Air Data Continuity Study Test Plan for the Sippican B2 and Vaisala RS92 NGP Radiosondes

Prepared by
NWS Observing Systems Branch

Updated April 20, 2012

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

Table of Contents

Figures

Tables

ACRONYMS AND ABBREVIATIONS

TERMS	DEFINITION
MicroART	Microcomputer Automatic Radio-theodolite
BILS	Balloon Inflation Launch Shelter
CDU	Control Display Unit
DCA	Data Control Assembly
FSD	Frequency Setting Device
GMD	Ground Meteorological Device
GPS	Global Positioning System
hPa.	Hectopascal
IF	Intermediate Frequency
KHz	Kilohertz
LOS	Line-Of-Sight
Mb	Millibar
PSI	Pounds Per Square Inch
IB	Inflation Building
MHz	Megahertz
MSL	Mean Sea Level
NCDC	National Climatic Data Center
NEC	National Electrical Code
NFPA	National Fire Protection Association
NOTAM	Notice to Airman
PITS	Protocol Interface Tests Suite
RF	Radio Frequency
RRS	Radiosonde Replacement System
RSOIS	Radiosonde Surface Observing Instrument System
RTS	Radiosonde Test Stand
RWS	RRS Workstation
SDM	Station Duty Manual
SFSC	Sterling Field Support Center
SPS	Signal Processing System
SPSS	Statistical Package for the Social Sciences
TRS	Telemetry Receiving System
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
UTC	Coordinated Universal Time
WMO	World Meteorological Organization
WSH	Weather Service Headquarters

1.0 Introduction

The National Weather Service (NWS) has developed the Radiosonde Replacement System (RRS) to replace its antiquated Microcomputer Automatic Radiotheodolite (MicroART) system, which has been in operation since the late 1980s. Recent Types of radiosondes flown in the legacy NWS network include the Sippican B2®, and MARK II®. These radiosondes are being phased out of the NWS upper air network with the introduction of the new Global Positioning System (GPS) radiosondes.

One significant impact the new GPS radiosondes have on operations are changes to sensors for temperature, pressure, and relative humidity measurements. These current generation sensor suites have differing characteristics from legacy radiosondes. Two radiosonde vendors, Lockheed-Martin Sippican and Vaisala, have developed 1680-MHz GPS radiosondes of this new design.

Because of these known changes and the potential impact on the long-term climate upper air record, a NWS directive was implemented to ensure that credible data continuity studies be conducted. As a result, a data continuity study is needed for assessing impacts as a result of the change in instrumentation for climatic and meteorological conditions.

The Upper Air Data Continuity Study (DCS) will determine what component of the total change seen in the climatic data is a result of true climatic variation and what component is related to a change in sensor technology, algorithm changes, and new procedures. Climatic change can be deduced by eliminating other factors, such as seasonal and annual effects, as well as differences in measurement. This plan only focuses on the NWS approach to ascertaining the measurement differences.

1.1. Data Continuity Goals

Dr. Thomas C. Peterson and Imke Durre from the National Climatic Data Center (NCDC) wrote in their report for the 15 January 2003 Meeting of NOAA’s Council on Long-term Climate Monitoring: “The goal of this report is to define a continuity strategy for the Radiosonde Replacement System (RRS) transition. But more than that, it is to develop some metrics to assess what the appropriate strategy should be. When working on this assessment, it became clear that consideration should be given to radiosonde continuity beyond the RRS transition, beyond it in both time and space. Specifically, this means looking to the more distant future of NWS radiosondes and also looking at the Caribbean Hurricane Upper Air Stations (CHUAS) that the NWS supports, particularly the Caribbean GCOS Upper Air Network (GUAN) stations.”

“In order to adequately assess the bias caused by the RRS transition, it is recommended that approximately 200 dual sonde flights be performed at each station. There are also enough dual sonde flights for the 95% confidence limit on the impact of the RRS transition induced discontinuity on a CONUS averaged tropospheric time series to be less than 0.05°C. The 0.05°C threshold was selected because it is one third of the controversial difference between two global satellite-derived tropospheric temperature time series adjustments for the discontinuity associated with the NOAA-9 polar orbiting satellite."

"The dual sonde flights are recommended to take place at a minimum of 17 and preferably 19 carefully but subjectively selected NWS radiosonde climate stations: four stations in Alaska, nine in the CONUS, five in the tropical Pacific and one NWS station in the Caribbean. In addition, one NWS supported CHUAS GUAN station was recommended for dual sonde flights." They also wrote in their report: "The second of ten basic 'climate monitoring principles' endorsed by the National Research Council (NRC) and United Nations Framework Convention on Climate Change (UNFCC) is of particular relevance. It reads: Principle 2. <u>Parallel Testing:</u> Operate the old system simultaneously with the replacement system over a sufficiently long time period to observe the behavior of the two systems over the full range of variation of the climate variable observed. This testing should allow the derivation of a transfer function to convert between climatic data taken before and after the change. When the observing system is of sufficient scope and importance, the results of parallel testing should be documented in peer-reviewed literature."

"Radiosondes, which unarguably meet the 'sufficient scope' and 'importance' criteria mentioned in the preceding Principle, are tested for accuracy and reproducibility in environmental chambers or factory tests, but natural exposure cannot be fully simulated in artificial or limited flight conditions. Instrument biases can vary with altitude, sensor, atmospheric conditions, sun angle, time of day, and other changes. Atmospheric quantities are continuously variable in time and space. Therefore, to address these data continuity concerns and to adhere to the climate monitoring principles, repeated measurements of the same quantities in a range of field environments will likely be required in order to determine differences between dissimilar radiosonde suites."

All National Centers for Environmental Prediction (NCEP) centers use upper air data in the conduct of their mission. Upper air data is considered an important data set in the preparation of daily prognoses and analyses on the state of the atmosphere. First-guess fields are generated in their models for assessing the forecast periods. Examples of these are the various analysis charts, e.g., 1000, 925, 850, 500, 100, and 20 hPa charts, freezing level charts, and the aviation model. The Tropical Prediction Center (TPC) uses soundings in relation to the formulation and intensity of tropical weather. The Hydrometeorological Prediction Center (HPC) uses upper air data to ascertain the degree of heavy precipitation for determining drought situations based on the upper level high-pressure domes. The Climate Prediction Center (CPC) uses upper air data for monitoring climate variability and change. Other centers use the data in research and in the development of new products.

1.2 General DCS Operations

The general plan for DCS operations is as follows:

- Sites will have both MicroART and RRS installed and operated in tandem during DCS operations (refer to Section 4.5 DCS Operations);

- A flight train with both legacy and RRS radiosondes will be suspended in close proximity to each other under a balloon/flight train; and
- Dual launches will be conducted and the data processed, operationally, into "archive files" before being transferred to NCDC.

The upper air data is collected, processed, and disseminated as World Meteorological Organization (WMO) TEMP-35/PILOT-32 messages to the meteorological community and the public. Section 4.5 describes MicroART and RRS operations in detail.

1.3 DCS Observations

Sites have been selected and a schedule of dual observations has been planned. NWS will launch the dual radiosondes using a technique developed by the Sterling Field Support Center (SFSC). The technique allows for the capture of data from both radiosondes along with the GPS geometric heights. The technique is described in Attachment C, Guide to Dual Flight Operations: Preparing and Releasing a Dual Flight Bar.

1.4 Joint System Configuration

One of the difficulties with finding the bias in measurements is in understanding how upper air data is acquired. The radiosonde telemeters temperature, relative humidity, and pressure engineering measurements to the ground system. The engineering units process them into meteorological parameters and assign a time stamp, nominally 1-second in the Radiosonde Replacement System (RRS) and 6-second to the Micro-ART data. Heights and winds are then calculated based on this information along with positional data for the winds to be calculated. These data are then compiled into datasets for processing into their final form of coded messages for world-wide distribution and two NCDC archive files – a standard Federal Coordinator for Meteorological (OFCM) format and a "high-resolution" 6-second Micro-ART format. Note that RRS is delivering a 1-second BUFR format archive file to NCDC in addition to the OFCM formatted archive. The dual flight system configurations can be seen in Figures 1 and 2. Attachment B contains the format used for the legacy system MicroART levels data and the high resolution data format used with the Radiosonde Replacement System. The two issues resulting from this process related to the DCS are:

- The clocks between systems will drift causing an additional uncertainty to the measurement bias; and
- Geo-potential heights used by climatologists to compare data also have uncertainties due to errors in the temperature, relative humidity, and pressure measurements.

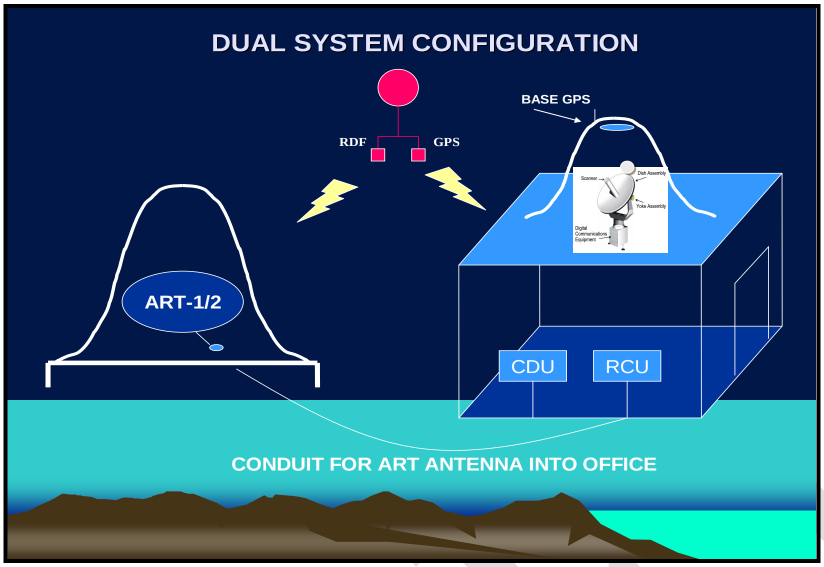


Figure 1. Dual System Configuration

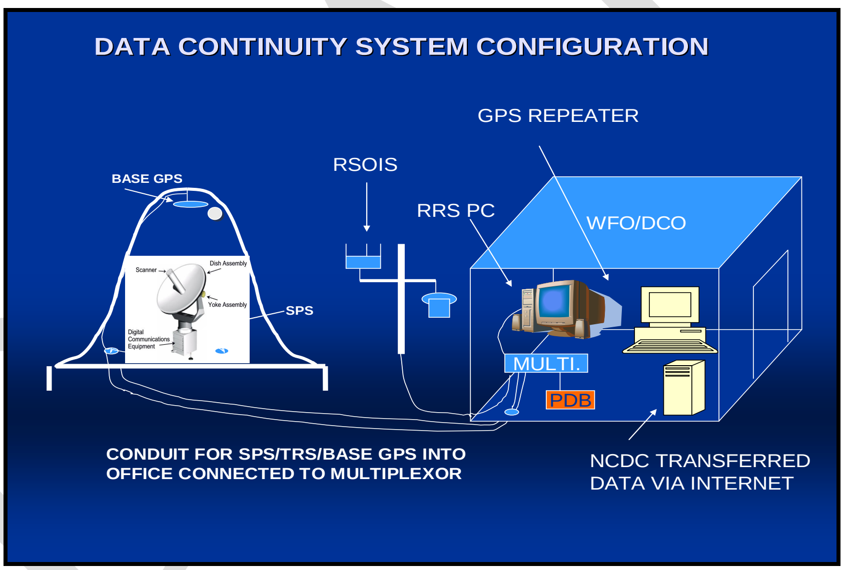


Figure 2. Dual Continuity System Configuration

2.0 DCS Plan

Below are the general plan components for the DCS as well as the requirements for its conduct.

2.1 NWS Site Selection

The NWS plans to meet these goals through the selection of NWS locations meeting the diversity of meteorological and Climatological conditions as suggested below. Figure 3 illustrates the candidates recommended for these locations. The 17 sites in the Petersen/Durre report constituted the NWS portion of the International Global Climate Observing Systems, Upper Air Sites.

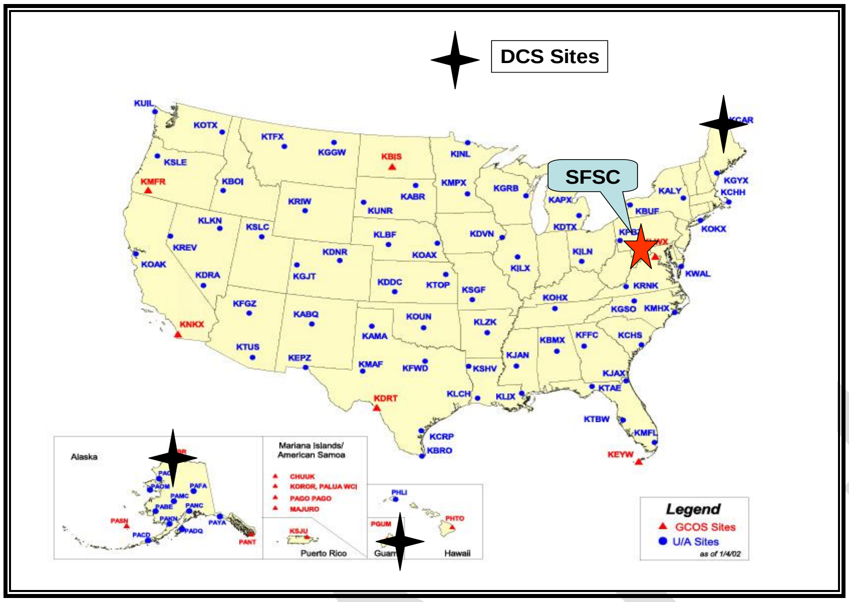


Figure 3. Recommended Data Continuity Study Sites

Budget considerations reduced the candidate DCS sites to three from the recommended 17. The three sites identified were Caribou, ME, Barrow, AK, and Tiyan, Guam. The SFSC test site at Sterling, VA has also been included as a fourth site, since it routinely performs this function as part of its test mission. The four stations selected are representative of the mid-latitudes, arctic and tropical climate regions of the U.S. network. The final DCS sites are identified with the large star.

2.1.1 SFSC Sterling, Virginia

The SFSC Sterling, Virginia site has a humid subtropical climate with warm summers. Its location in the middle latitudes has a general atmospheric flow from west to east which favors a humid subtropical climate with four well defined seasons. Summers are warm and at times humid. Winters are generally mild with the coldest period occurring in late January when temperatures average 21° F. The warmest period where temperatures average 88°F occurs in the latter part of July.

Precipitation is rather evenly distributed through the year. Annual precipitation has ranged from about 25 inches to more than 55 inches. Rainfalls of over 10 inches in a 24-hour period have been recorded during the passage of tropical storms. The seasonal snowfall is nearly 24 inches, but varies greatly from season to season. Snowfalls of 4 inches or more occur only twice each winter on average. Accumulations of over 20 inches from a single storm are extremely rare.

Prevailing winds are from the south except during the winter months when they are from the northwest. The windiest period is late winter and early spring. Winds are generally less during the night and early morning hours and peak during the afternoon. Winds may reach 50 to 60 miles per hour or higher during severe summer thunderstorms, hurricanes, and winter storms.

2.1.2 Caribou, ME

The Caribou site has a Humid Continental Climate with cool summers. While the location is 150 miles from the Atlantic coast, this factor does not alleviate the continental influences that result.

Winters are particularly long and windy, and seasonal snowfalls averaging over 100 inches are not unusual. Temperatures of zero or lower normally occur over 40 times per year.

Summers are cool and generally favored with abundant rainfall. Since Caribou, ME is located high up the St. Lawrence Valley, if often comes under the influence of the Summer Polar Front which results in practically no dry periods of more than three to four days.

Autumn weather is characterized by mostly sunny warm days and cool nights.

2.1.3 Barrow, AK

The Barrow upper air location is classified under the Polar Tundra climate. With the Arctic Ocean to the north, east, and west, and level tundra stretching 200 miles to the south, there are no natural wind barriers to assist in stalling the wind, permitting the lowering of temperatures by radiation, and no down slope drainage area to aid the flow of cold air to lower levels. Consequently, temperature inversions in the lower levels of the atmosphere are not extreme. Temperatures remain below the freezing point through most of the year, with the daily maxima reaching higher than 32°F on an average of only 109 days per year. Freezing temperatures have been observed every month of the year. February is generally the coldest month and March temperatures are slightly higher than those observed in the winter months. In April, temperatures begin a general upward trend, with May becoming the definite transitional period from the winter to summer season. July is the warmest month of the year and the frequency of minimum temperatures of 32 degrees or less are about one day out of two for July and August. During late July to early August, the Arctic Ocean is usually ice-free. Summer ends in September and by November, half of the mean temperatures are below zero as winter commences once again.

At 12:50 p.m. on November 18, the sun dips below the horizon and does not appear again until 11:51 a.m. on January 24. By 01:06 a.m. on May 10, the possible sunshine has increased to 24 hours per day and remains visible until August 2.

Sunshine appears to have a direct relationship to the occurrence of cloudiness, precipitation, and heavy fog. All three build up to a maximum with the hours of sunshine. Maximum cloudiness continues into the fall although the amount of sunshine, precipitation, and fog are on the decrease.

Wind speed variation during the year is small, with the fall months being windiest. Extreme winds in the upper 40s and the low 50s have been recorded in all months.

2.1.4 Tiyan, Guam

Guam's climate is classified as Tropical Wet and Dry. The location of the upper air site is on the western side of the Northern Plateau. Trade winds reach the station after rising sharply up the 500 foot cliffs on the eastern side of the island. The trade winds which blow from the east or northeast are strongest and most constant during the dry season, when wind speeds of 15 to 25 mph are very common. During the rainy season there is often a breakdown of the trades, and on some days the weather may be dominated by westerly-moving storm systems that bring heavy showers or steady, sometimes torrential rain. Occasionally, there are typhoons that bring tremendous rains as well as violent winds. The most frequent occurrence of typhoons is in the latter half of the year although they have passed sufficiently close to produce high winds and rain in every month.

The climate of Guam is almost uniformly warm and humid throughout the year. Afternoon temperatures are typically in the middle 80s and nighttime temperatures typically from the low 70s or high 60s. Relative humidity ranges from 65 to 70 percent in the afternoons to 85 to 100 percent at night.

There are two primary seasons and two secondary seasons in Guam. The primary seasons include the four-month dry season from January through April, and the four-month rainy season from mid-July to mid-November. The secondary seasons are May to Mid-July and mid-November through December. On average, about 15 percent of the annual rainfall occurs during the dry season and 55 percent during the rainy season.

2.2 System Descriptions

2.2.1 Micro-ART

Figure 4 delineates the types of systems in use today including the MicroART system (a variant of the Automatic Radiotheodolite for the Ground Meteorological Device or GMD).

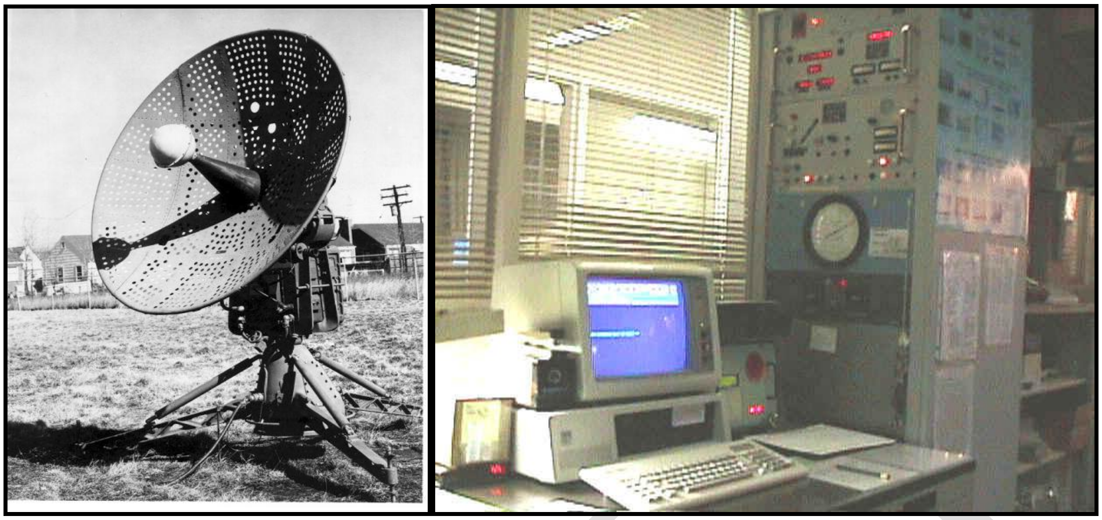


Figure 4. MicroART System including Ground Meteorological Device

Figure 5 lists the types of legacy radiosondes previous flown in the NWS network including the Sippican B2®, MARK II® variety, and the Vaisala RS 80®. The RS-80-57H was phased out of the network in the summer of 2010 and the Sippican (VIZ) B2 will be phased out of the NWS operated network by late summer 2013 and replaced with GPS-based radiosondes. Two radiosonde vendors, Lockheed Martin Sippican and Vaisala have developed radiosondes of this new design.

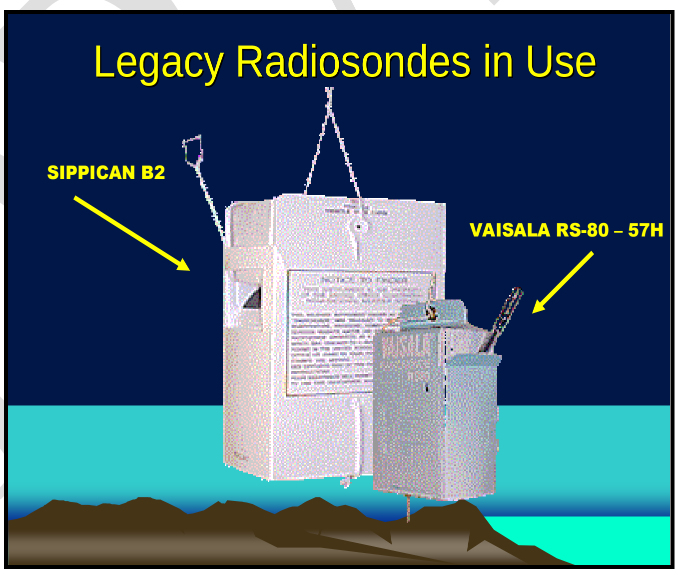


Figure 5. Radiosondes flown with MicroART

2.2.2 Radiosonde Replacement System

The RRS is comprised of a new GPS tracking antenna referred to as the telemetry receiving system (TRS), 1680 MHz GPS radiosondes and Signal Processing System (SPS), and a new NTbased workstation. In addition to the deployment of the RRS, a new surface weather observing system called the Radiosonde Surface Observing Instrumentation System (RSOIS), and precision digital barometers were deployed at most of the102 locations from the Caribbean to Guam and from Alaska to Pago Pago, American Samoa in the Southern Hemisphere. Sites not using the RSOIS will use the Automated Surface Observing System (ASOS) and enter the observation manually into the workstation during prelaunch activities. GPS Repeaters are installed to improve GPS reception within the office environment during radiosonde baselining procedures.

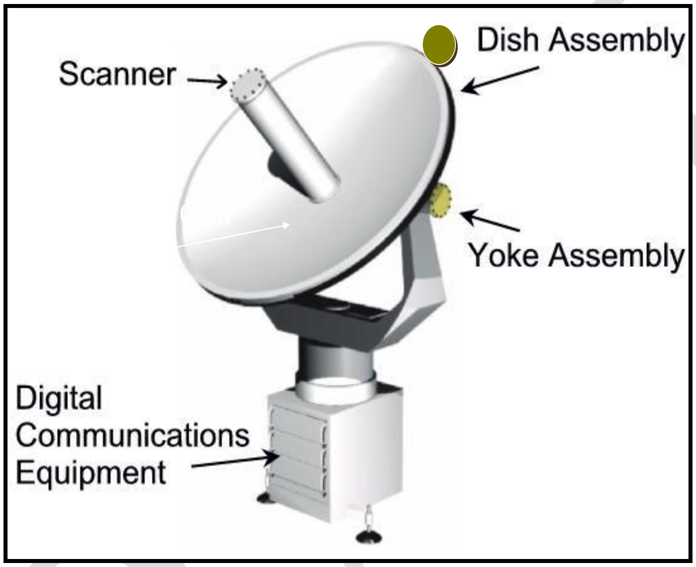


Figure 6. RRS Antenna

The RRS shown in Figure 6 has been deployed in a phased approach to most of the 91 locations scheduled to receive systems. NWS will be conducting an Operational Test and Evaluation (OT&E) at selected sites in the spring 2012 for the Build 2 workstation software and another OT&E as part of the initial deployment of the climate-quality radiosonde. The purpose of this latter OT&E will be to validate system/radiosonde usability, evaluate system/radiosonde performance in a field setting, and determine if any critical problems exist before build 2 software deployment commences.

2.3 Description of Radiosondes

2.3.1 Vaisala RS92-NGP Radiosonde

The Vaisala RS92 radiosonde uses a digital data transmission scheme modulated at 1680 MHz. The sensor suite consists of a silicon capacitive pressure sensor, a rode type capacitive temperature sensor and two alternately heated thin film capacitor sensors for RH measurement. A spiral GPS antenna is positioned on the top of the radiosonde and receives a GPS position every second which then translates into wind speed and direction. Figure 7 is the RS92-NGP radiosonde. Sensor data are telemetered to the ground station at an approximate rate of once every second. At the ground station, the receiver demodulates the signal and sends the data to the

Vaisala signal processing system (SPS) in the pedestal of the TRS. The SPS converts the signal to meteorological units, and then passes the data via a fiber or RF link to the RWS in the office.

Figure 7. Vaisala RS92-NGP Radiosonde

The Vaisala frequency setting device must be used to set the frequency of the RS92 radiosonde frequency. This unit is simple to use and has four selectable frequencies. In addition to setting the frequency of the radiosonde, it also burns of contaminates which may have collected on the humidity sensors. Figure 8 is a picture of the device with the radiosonde in the cradle.

Figure 8. Vaisala RS92-NGP Radiosonde on Frequency Setting Device

2.3.2 LMS B2 1680-MHz Radiosonde

The LMS B2 radiosonde is an amplitude modulated 1680 MHz radiosonde which is depicted in Figure 9. The sensor suite consists of an aneroid pressure cell, a carbon element humidity sensor, and a ceramic rod resistive temperature sensor. Sensor data are telemetered to the ground station at an approximate rate of once every second. At the ground station, the receiver demodulates the signal and sends the data to the Automatic Radio Theodolite Interface Card (ARTIC) in the MicroART computer. The ARTIC card converts the signal to period values, and then passes the data to MicroART software version 2.92 for conversion to meteorological units. MicroART software filters, smooth's, and processes the data into a six-second data format which is used for coding messages and other files used by the NWS.

Figure 9. Lockheed Martin Sippican B2 Radiosonde

The Climate community's interest in the Lockheed Martin Sippican B2 legacy radiosonde originates from the fact that it is the last of a long line of radiosondes using the large rod resistive type temperature sensor dating back to the late 1950s. The large rod thermistor has been flown at the candidate DCS sites for an extended period and offers the best chance to get temperature change signatures. Attachment A contains a history of the legacy radiosondes using the large rod thermistor as well as other changes in Relative Humidity and pressure that also influenced radiosonde performance over the network in the past. Included in the appendix is individual station history information for the SFSC Sterling, Virginia site, Caribou Maine, Barrow, Alaska, and Tiyan, Guam.

3.0 DCS Requirements

The following sections describe the general requirements for the pre-requisites and conduction of the Data Continuity Study.

3.1 Pre-requisites for the DCS

The DCS is the culmination of a number of key steps as shown in Figure 10. Four major components to this process are as follows:

- Acquisition
- RWS Software
- Documentation
- Test cycles

The acquisition of the radiosondes to be used in the DCS will be climate-quality instruments. The radiosondes will be produced in a production facility which utilizes production quality control tests before delivering the instruments to the NWS for further testing. The updates required for the RWS Build 2 software for the new radiosonde and its associated development tests will be completed. All the documents which need to be generated in support of the new radiosonde including the RRS Workstation User Guide, software installation instructions, and the modification note to the RRS system for the new SPS must be completed. The System Test and Operational Test and Evaluation will be successfully completed before the NWS begins DCS operations. As indicated in Figure 10, several of these activities will be completed in parallel.

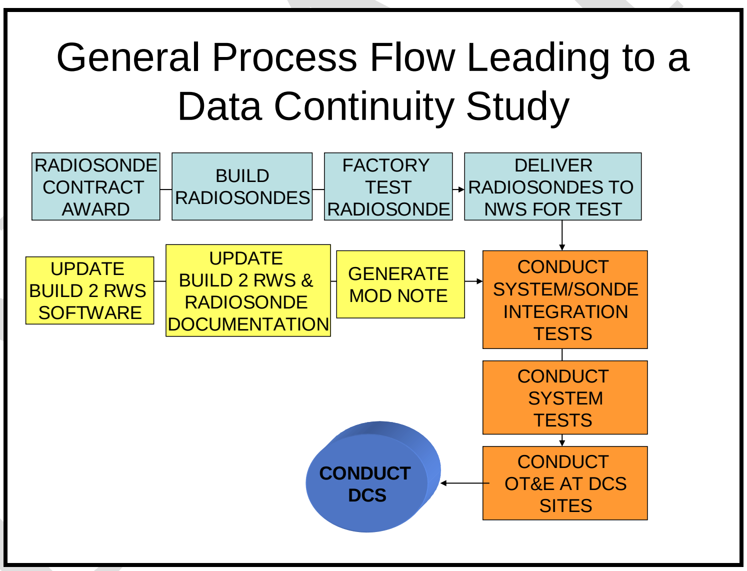


Figure 10. Major Steps leading to DCS

3.2 Minimum Requirements

To ensure that there is sufficient data for the purposes of statistical analysis, the guidelines outlined in Table 1 will be used to determine the desired minimum number of valid flights reaching specific pressure levels:

Flight Performance	Minimum Pressure	Required # of Flight
Minimum	30	120

Target	20	90
Target	10	75

Table 1. Pressure level requirements by number of flights

If the required number of flights is not met, the Weather Service Headquarters (WSH) may request additional flights to be conducted. An HM-32 type 1200 gram balloon will be used to ensure the payload reaches the highest possible altitude, although the target height is 10 hPa level, the minimum level for a successful flight is 30 hPa. Pressure levels to be evaluated in the report are, at a minimum: 1000, 925, 850, 700, 400 500, 250 300, 200, 150, 100, 70, 50, 30, 20, and 10 hPa. The DCS parameters for quantitative analysis are pressure/heights, temperature, and relative humidity. Winds will only be evaluated, qualitatively. In addition, since the SFSC will have time-synchronized releases the data will also be analyzed as a time-paired series. The SFSC will monitor and perform statistical analyses of each site's performance in terms of height requirements and data quality. Sterling will coordinate with NCDC to ensure all DCS data sets have arrived. Additional time may be required to meet the 120 required flights for the following reasons:

1. Office operations precludes a scheduled flight;
2. Weather conditions not conducive to either a successful flight or deemed unsafe for launch;
3. One or both radiosondes are deemed unsuccessful during flight – see Section 3.2.

Stations will select a day-of-the-week, e.g., Thursdays, to conduct both the 00Z UTC and 12 UTC dual flights and adhere to this schedule until the 120 number has been obtained. The day selected will be reported to the SFSC Project Manager (PM), Mr. Jim Fitzgibbon.

3.2.1 Successful Flight Requirements

For a DCS flight to be deemed successful, the following criteria must have been attained:

1. Baselining of both instruments have been conducted in accordance with NWS procedures, correctly;
2. Both radiosondes have obtained an altitude equivalent to at least the 30 hPa level with the goal being to obtaining 10 hPa;
3. Missing data does not exceed requirements found in NWS handbooks; and
4. Data from both radiosondes has been processed into bona-fide archive files and transmitted to NCDC with their acknowledgement of receipt.

Flights not meeting these requirements will be deemed unsuccessful. In these cases, dual flight will not count towards the minimum requirement; however, the data will be collected and held on site awaiting further guidance from the SFSC PM.

3.2.2 DCS Conclusion

When the above requirements have been fulfilled, the DCS will be concluded at each site independent from the other sites and guidance will be provided by the SFSC PM to terminate DCS operations. Actions to decommission and dispose of legacy equipment/expendables will be provided at that time.

3.3 Test Policy Requirements

Test policies and requirements will be followed during test operations. These policies have been established to maintain procedural consistency across sites and to ensure DCS data requirements are met. If at any time there is a question regarding the test and the question is not clearly addressed in the test plan, personnel are encouraged to contact the SFSC PM for guidance or clarification.

- During the DCS, the RRS will be operated as the official system of record and the Micro-ART legacy system will be in a secondary role. Note, this means data edits and QC procedures will be applied to the RRS data. MicroART products will not be transmitted but will be archived using existing procedures.
- Once the training team has departed the site, DCS soundings will be taken every seven days at the same synoptic time, 00 UTC and 12 UTC. A total of a 120 successful dual observations are required. Every effort should be made to maintain the seven day test cycle. Missed or unsuccessful DCS flights will be appended to the end of the test period. The test period is sixty weeks with an extension of 10 weeks for make-up flights.
- If it becomes apparent that two or more consecutive test flights will be missed, the SFSC should be notified. All missed flights will be recorded on the DCS web site. Plausible reasons for missing a test flight are as follows:

    - Office operations would be adversely impacted if site performs DCS flight as scheduled;
    - Conditions exist which may result in injury to personnel or property if the DCS flight is attempted;
    - One or both ground stations are working improperly;
    - Weather conditions are such that a successful release would not be likely;
    - At the request of the SFSC or NWSHQ; and
    - No inflation gas available.

- For the DCS, a successful flight is one which reaches 30 hPa. If a flight is unsuccessful, no DCS second release will be attempted. **Station personnel will follow the local policy on second release requirements for the operational sounding.** If the MicroART radiosonde fails or is damaged during release and the RRS radiosonde is still functioning correctly, the flight will be continued for operational purposes. This flight will be logged as a failed DCS flight.
- Test personnel will determine if a flight has anomalies which may have an adverse impact on data quality. These flights will be flagged as suspect on the DCS web site. A test flight may be flagged as suspect for the following reasons:

- Train assembly becomes entangled on radiosondes during release;
- Radiosondes hit ground or other obstruction during release;
- Interference of any kind is encountered on either or both systems;
- Radiosonde malfunctions during flight;
- Ground equipment problems occur during flight; or
- Any non-operational conditions exist that may result in an unfair comparison.

- Testing may be suspended if at any time the SFSC and WSH determine test objectives are being jeopardized for any reason. Additionally, if for any reason the site or regional headquarters wishes to suspend the test, requesting personnel will coordinate with the SFSC to have a conference call with all concerned parties to discuss the request. In either case the SFSC will mediate the appropriate action.

4.0 DCS Methodology

The following sections describe the general steps in the process at each field site in the study. Additional information can be found within the following resources:

- Guide to Dual Flight Operations: Preparing and Releasing a Dual Flight Bar
- Guide to Dual Flight Operations: Performance Checklist for Vaisala RS92-NGP and Sippican B2
- Guide to Dual Flight Operations: Techniques and Processes for Success

4.1 Test Preparation

The start date for the DCS is predicated on the site conducting the RRS deployment training requirements and approximately 30 days of using the system operationally. Operational use of RRS will be coincident with the *Operational Test & Evaluation (OT&E) Plan for Deployment of the Vaisala RS92* and the Radiosonde Replacement System (RRS) Workstation Subsystem (RWS) Build 2.2 software.

There are numerous activities which will need to be completed at least 60 days prior to the commencement of the DCS. These activities will be orchestrated by the SFSC and appropriate personnel from WSH. Site specific preparation will generally consist of station personnel familiarizing themselves with the DCS and associated processes. Station management will also need to schedule personnel for maximum participation in the SFSC onsite familiarization training. Stations can begin the DCS familiarization at their own discretion; however the SFSC recommends personnel begin this familiarization two weeks after the site begins operational use of the RRS. This will allow the site personnel an opportunity to build up their competency with the RRS before starting the DCS operations.

4.2 Test Metadata

For each of the DCS sites, SFSC personnel will conduct a comprehensive site survey for the MicroART, RRS and the surface observation equipment used for the surface observation associated with the upper air sounding. This information will constitute the site metadata for the DCS and will be part of the official test record. It will be provided to NCDC for archiving as part of test data record. A subset of these documents will also be available on the DCS web site. Attachment G is the SFSC DCS Site Survey Operating Procedure Manual for conducting site surveys and Attachment H is the template for development of the site Metadata file.

4.3 DCS Dual Flight Operations Familiarization.

The SFSC will be responsible for familiarizing site personnel in DCS dual flight operations. As a familiarization aid the SFSC will have a DCS dedicated web site. This site will have all documents associated with the DCS, but more importantly all familiarization material will be available through this site. Available material includes the following:

- Guide to Dual Flight Operations: Preparing and Releasing a Dual Flight Bar (Attachment C), which is a step-by-step guide for equipment warm-up, balloon inflation and train assembly, radiosonde preparation, and release site processes

- Guide to Dual Flight Operations: Performance Checklist for Vaisala RS92-NGP and Sippican B2 (Attachment D), which provides a sequence action checklist prior to and after the dual flight using both the Vaisala and Sippican B2 radiosondes

- Guide to Dual Flight Operations: Techniques and Processes for Success (Attachment E), which is a presentation that provides an overview of the dual flight process while justifying reasoning for common practices, also used during on-site DCS familiarization

- Guide to Dual Flight Operations: Vaisala RS92-NGP Preparation and Performance (Attachment F), a presentation which provides a more in-depth analysis of the radiosonde, how it should be handled and prepared, and its in-flight performance

- How to Perform a Successful Dual Flight video, which will assist observers in performing common flight procedures, such as preparing the flight train and releasing a dual flight bar

- Preparing Radiosondes for a Dual Flight video, which will assist the observer in preparing the Sippican B2 and Vaisala RS92-NGP radiosondes for a dual flight

- Data Continuity Study Input Form completion

Approximately one month (~30 days) after the site has successfully transitioned to RRS, they will independently begin the DCS and dual flight operations upon coordination with SFSC. On site familiarization for the DCS will take place during the second week when SFSC initially arrives to convert the site to RRS. This familiarization will consist of a 2 hour classroom session which will be followed by four to six DCS flights. These flights will be conducted at synoptic time and used as the operational sounding. On the first two flights, SFSC will run a data quality check as a means of verifying the integrity of the two ground stations. If no problems are identified, these flights will be archived as part of the official test data. Additionally, these data sets will be retained by SFSC as the benchmark for monitoring system performance for the duration of the test. All familiarization flights which meet the DCS data requirements will be counted towards the total number of flights for the test.

Activity	Start	duration
SFSC travel to test sites	Site specific to allow for travel	2 days
Briefing and Site Q&A session	Day 1 (on site)	1 hour
Systems check-out	Day 1 & 2	8 hours
Compile Metadata (surveys)	Day 1 & 2	12 hours
Classroom training	Day 2	2 hours
Start DCS training flight	Day 2 or 3 through day 5 (start first 00 UTC sounding after classroom session)	
Final DCS training Flight & Site debriefing	Day 5	
SFSC personnel depart site		2 days

Table 2. Schedule of SFSC Week Two onsite DCS Activities

4.4 Radiosonde Test Stand

The SFSC will be responsible for the assembly and installation of the Radiosonde Test Stand (RTS). The RTS will be shipped as a kit ready for assembly. When the SFSC team arrives onsite for the training, they will work with site personnel to determine the best location for the RTS. Once the site is selected, SFSC personnel will coordinate or perform the assembly and installation of the RTS. However, if so desired, each site has the option to install the RTS in advance of the SFSC arrival. If they choose to install the RTS, they should first coordinate with the SFSC on the location. The RTS will be assembled and installed in accordance with the RTS Installation Instructions details in Attachment I. Figure 11 demonstrates the RTS used at the SFSC.

Figure 11. SFSC Radiosonde Test Stand (RTS)

For the field sites, the RTS will be nearly identical to what is pictured here. There is, however, another option which can be used to install the RTS. This utilizes a 61 cm (24 inch) mailbox spike which is pounded into the ground for a permanent installation.

4.5 DCS Operations

In order to meet test objectives and data requirements, test personnel should make every effort to follow the processes outlined in this document and its attachments. To capture the meteorological and climatic conditions which occur at each station, the test will cover a period of sixty weeks and consist of a minimum of 120 successful dual flights. Unsuccessful flights will be made up in the 10 weeks immediately following the original test period. Flights will be conducted every 7 days at 00 UTC and 12 UTC. Each site will select the day of the week for the DCS flight and this will not change. The flight train assembly, if assembled correctly will conform to the vertical height requirements in the ASTM D4430 Standard Practice for Determining Operational Comparability of Meteorological Measurements. This document specifies that for operational comparability of meteorological measurements should measure the same ambient atmosphere. To achieve this, the recommended measured cylindrical volume should be less than or equal to 10 meters in the horizontal and the vertical extent of the volume must be the lesser of one meter or one tenth of the height above the earth's surface of the base of the volume. Figure 12 shows the flight train and spreader bar assembly being properly prepared for flight.

Figure 12. Preparation of dual flight train and spreader bar assembly

Figure 13 illustrates the horizontal and vertical spacing relationship of the radiosondes as they are released and ascend through the atmosphere. Thus, care when attaching the radiosondes to the spreader bar should be taken to suspend the radiosondes at the same height with respect to each other.

Figure 13. Dual flight bar release at SFSC

4.6 NCDC Archive and Data Analysis

The following steps provide an outline of what is expected from each site:

1. The NWS is required to provide the NCDC all products issued over its

telecommunications and higher resolution data sets for use by researchers and other users. NCDC also provides NWS with performance-related data for quality control purposes.

2. When the high-resolution data sets are received at NCDC, they will perform a quality control check to determine if the dual flight data was deemed acceptable. A web site will post the results and keep track of each station's activities. If a quality control problem exists, the station will be notified quickly in order to correct the problem. If, for some reason, the problem cannot be corrected, that dual flight may be culled from the results and another may need to be taken. NCDC will be processing the various data sets received from each station and entering them into a data base for future analysis by scientists attempting to determine the transfer function. Statistical techniques will be employed to ascertain this function and report their findings at the end of the study.

3. Four file formats (See Attachment B) will be delivered to NCDC as is done today for Micro-ART and RRS via a FTP protocol. Time will not be used for linking the datasets, except at the SFSC, because of the issues stated above. Rather, the links can be made by two alternative methods:

    - Define thickness layers in which all temperature or relative humidity data, for example, surface to 850 hPa, would be compared between radiosondes. Mean temperature differences and other statistical parameters would be derived for the thickness layers.

    - Use the GPS-derived heights along with the surface pressure and mean virtual temperature to compute accurate pressure levels, e.g., 850, 500, 20 hPa. The NWS has an algorithm to compute these pressures based on the geometric GPS heights. A direct measurement of height differences from the radiosonde-derived heights and the GPS-derived heights can also be obtained (See Figures 14 and 15).

4. The SFSC will be used to conduct timing tests for further research and analysis. Sterling has eliminated many of the issues with synchronizing radiosondes and is an authority on performing DCSs.

5. NCDC could consider using a regression analysis package for performing the analyses and generating the requisite graphics for the report. Regression plots are especially useful in defining bias transfer equations, since the data could be parsed into seasons, by parameter, and most importantly, by the newly-derived GPS pressure/height levels. The Principal Investigator (PI) would then determine the best curve to fit the dual flight data by level and then determine the regression equation for each parameter of interest. These transfer equations could then be used to adjust climate data sets and also answer the issue about transfer biases from one part of the network to another. For example, one could

look at the transfer equation from east of the Mississippi versus west and see if the transfer equations are different. Also Functional Precision comparisons for the same radiosonde could be made to see if the transfer equation changes from one site to another and compare that with the Functional Comparison between different radiosondes. The two figures below (Figure 14 and 15) illustrate how pressure/height biases could be determined using this method.

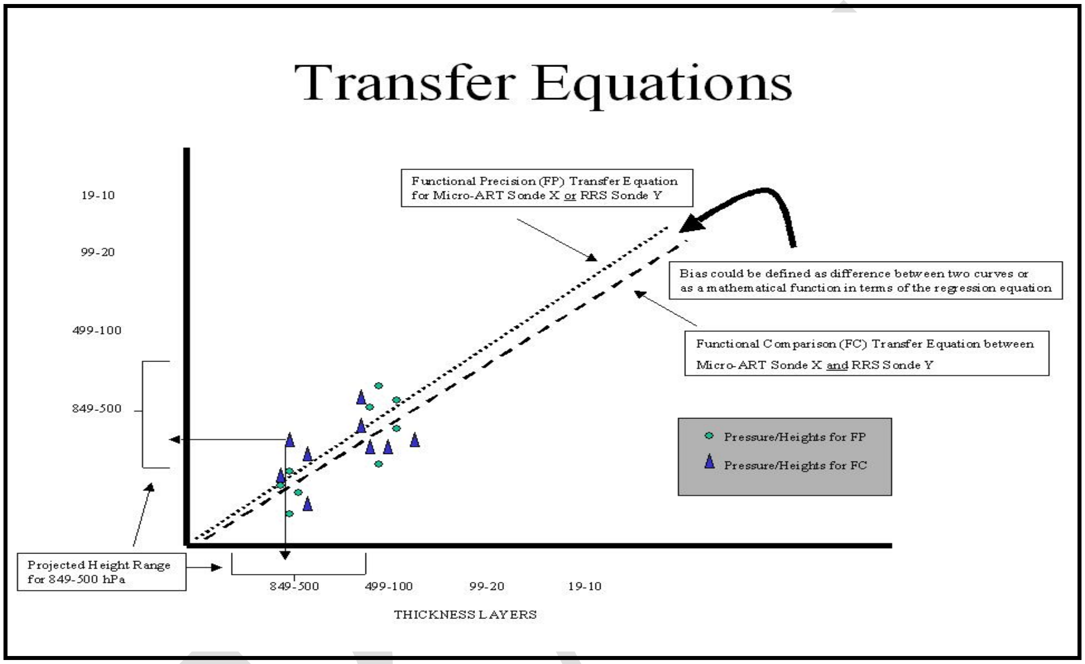


Figure 14. Transfer equations used for comparisons

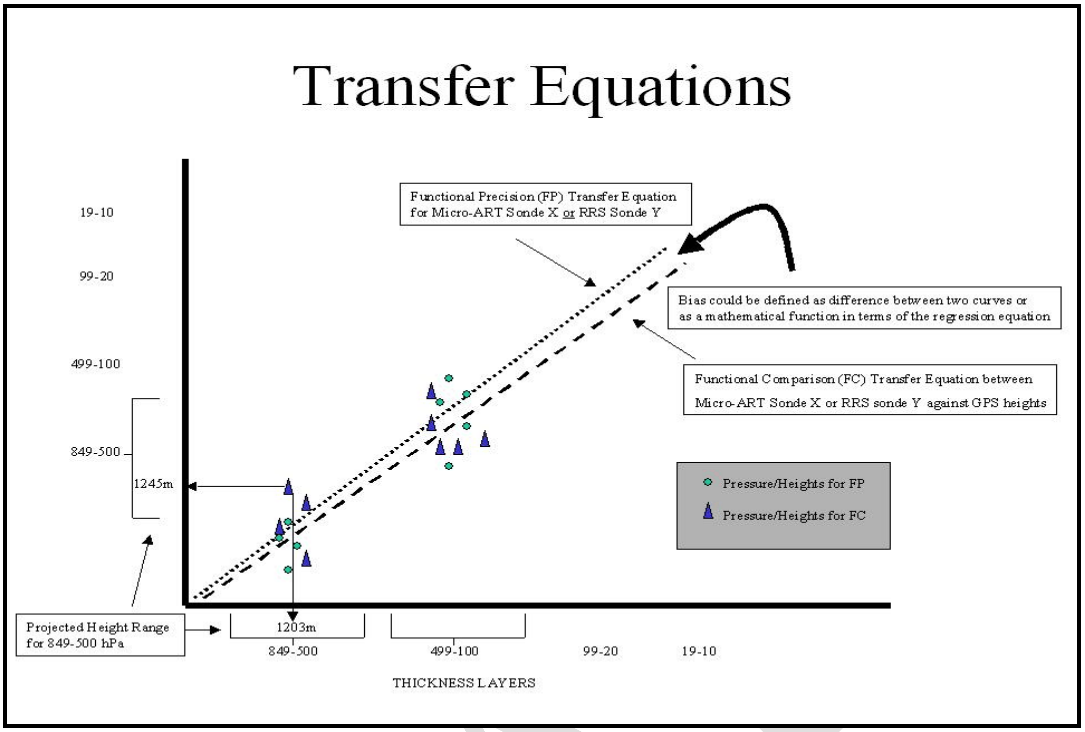


Figure 15. Transfer equations used for comparisons

6. An analogous method for temperature or RH could then be derived. Once the errors related to pressure heights are derived, then it makes sense to determine the errors associated with temperature and RH. What this means is there are three components to the error climatologists see in the data, ergo, the error in making temperature measurements, the corrections applied to it, and the assignment of the temperature to a particular pressure/height curve. For example the temperature error may be small at a particular tropospheric pressure height, say 400 hPa, but the pressure height curve for 400 hPa may itself be off by 50 meters, thus, assigning the incorrect temperature to the pressure/height. At 20 hPa, this could be 500m. The use of GPS-derived heights ought to provide some insight into the true nature of these curves. It may also provide insight into the temperature correction being used since the correction may in fact be making the measurement worse, instead of better.
7. NCDC will be responsible for providing the definitive DCS report to the climate community as well as others interested in the results.

5.0 Test Resources

The SFSC and WSH will be responsible for procuring and shipping the majority of the test expendables. The SFSC will ensure each site has a 120 day supply of test resources at least 30-60 days in advance of the projected DCS start date. Subsequent shipments of test resources are planned to minimize site storage requirements. Items to be procured and prepared for shipping by SFSC and WSH are as follows:

- **Balloons** – The SFSC will procure 1200 gram balloons in such manner to ensure the balloon shelf life is not exceeded. Balloons will be shipped at a nominal rate of 54 balloons every 90-120 days.
- **Parachute**s – Since dual flight operations require two parachutes per balloon, shipment of extra parachutes will be coordinated by the SFSC. The SFSC will supply one parachute for each dual flight to be conducted. The other will be provided by the office using the normal NWS logistics system. The SFSC will ship approximately 48 parachutes every 90-120 days.
- **RS92 Radiosondes** – Since the RS92 radiosonde will be the operational radiosonde, they will be shipped using the normal NWS logistics system.
- **MicroART B2 Radiosonde** – Shipment of new B2 radiosondes for this test will be coordinated by OPS22. Warranty or reconditioned radiosondes will not be used in the DCS.
- **Test Sites -** Stations must have adequate staff to conduct the DCS. WSH will be responsible for funding reasonable costs incurred in the preparation of the site and during the study.
- **Spreader bars** – The SFSC will have 500 Spreader bars manufactured. The spreader bar harness assembly will be attached at the SFSC prior to shipping. Bars will be packaged in quantities of 25 and shipped two packages at a time to each site.
- **Gas** – DCS flights will require approximately 40% more gas. Stations/Region will order the additional gas and incorporate it into the stations normal delivery cycle. WSH will compensate the station/region a nominal rate of 3 tanks per month. Region should inform the WSH of the additional expense.

For non-DSC flights, the field office is required to provide all materials and resources associated with normal operations.

5.1 Schedule of Milestones

The test will encompass a period of approximately 60 weeks. All DCS flights will be conducted on the same day of the week at 00 UTC and 12 UTC. In order to manage cost, it is recommended the DCS flight days be Tuesday, Wednesday or Thursday. Once training is completed and SFSC personnel depart, DCS flights will be conducted on the first designated day at both synoptic times. If there are missed or unsuccessful flights the test period will be extended to make up those flights. Table 3 below is an outline of the test schedule. Once the date is set for each site to commence operational use of RRS, an actual detailed DCS schedule will be published in coordination with the site and regional personnel.

Activity	Start	Duration
SFSC Pre-test activities	T - 90 Days (90 days before site starts RRS usage)	Three months
SFSC on site DCS training	T – 30 Days	One week
Site operational RRS usage	T - 30 Days	One month
Site DCS familiarization	T - 14 Days (Two week after start of RRS usage)	Two weeks
Test commencement	T + 0 (On selected day first week after DCS departs)	60 weeks
Test debriefing	T + 60 weeks	One day
Test make-up flights	T + 70 First week after initial test period	10 weeks
Test Wrap-up	T + 71 First non-test week after make-up flights	One day

Table 3. Schedule of DCS Activities

5.2 Roles and Responsibilities

The following describes the roles and responsibilities during the DCS:

Project Manager - Jim Fitzgibbon, SFSC Site Manager
Email: james.fitzgibbon@noaa.gov Phone: 703-661-1243
Directs and manages test activities and resources. Consults with DCS Readiness Coordinator on DCS start-up activities and the Test Quality Control Manager on test progress.

DCS Project Requirements – Carl Bower, OPS22 Upper Air Program Manager
Email: carl.bower@noaa.gov Phone: 301-713-2093 x 115
Coordinates with National Climatic Data Center and other upper air data users on their test requirements. Reviews monthly status reports to ensure DCS data requirements are being met. Recommends changes and extends test period if minimum DCS requirements are not achieved. Coordinate compensation to regions.

DCS Readiness Coordinator - Ashby Hawse, SFSC Upper Air Test Program Manager
Email: ashby.hawse@noaa.gov Phone: 703-661-1222
Responsible for the certification of the RRS System and MicroART at DCS sites. Onsite team lead for all aspects of DCS operations.

DCS Team Lead for Document Development and Review - Ryan Brown, SFSC Research Meteorologist/Upper Air Test Team Lead

Email: ryan.brown@noaa.gov   Phone: 703-661-1246
Manage development of all DCS documents. This includes test plans, user guides, training material and videos. Manages document development team.

DCS Radiosonde Logistics Manager – Bill Blackmore, OPS22 Operational Quality and Logistics Lead
Email: william.blackmore@noaa.gov   Phone: 301-713-2093
Manages and monitors all aspects of DCS B2 radiosonde deliveries. Monitors inventory of RS92 radiosondes in Kansas City. Consultant on all aspects of DCS operations.

DCS Helpdesk Coordinator – Dan Brewer, SFSC on-site CyberData Team Lead/Research Meteorologist
Email: daniel.brewer@noaa.gov   Phone: 703-661-1208
Manages DCS Helpdesk activities and coordinates DCS related travel.

DCS Quality Control Meteorologist - Katie Webster, SFSC Research Meteorologist
Email: katie.craven@noaa.gov   Phone: 703-661-1234
Oversees the day-to-day DCS activities. Reviews test results on a daily basis. Generates statistics and prepares monthly progress reports. Informs appropriate personnel of test progress and problems.

Metadata Development and Site Survey Coordinator – Greg Kochanowicz, SFSC Research Meteorologist
Email: gregory.kochanowicz@noaa.gov   Phone: 703-661-1226
Responsible for comprehensive site survey and compilation of site specific metadata.

On Site DCS Coordinator – Site specific, assigned locally.
Coordinates on site DCS activities, including siting of RTS and training. Informs SFSC of test related problems.

Site Personnel - As assigned by duty roster/shift rotation.
Evaluates current weather to determine if conditions are conducive for a successful balloon release. Informs SFSC if a flight is going to be cancelled. Performs test flights and documents all test activities on DCS web page at flight completion.

5.3 Expected Budget Profile

WSH will be providing funding to cover site costs for the additional support required to launch dual flights. Further guidance will be provided directly to the regions.

REFERENCES

Peterson, Thomas C, and Durre, Imke, December 31, 2002: A Climate Continuity Strategy for the Radiosonde Replacement System Transition, prepared for the January 2003 15 Meeting of NOAA's Council on Long-term Climate Monitoring, by, National Climatic Data Center/NESDIS/NOAA.

Peterson, Thomas C, Brewer M., Seidel D., Murray W., FY 10 Climate Observations and Analysis (COA) Program Mini-POP: <u>Replacement Radiosonde System Data Continuity Study (RRS DCS), April 2007</u>

Guide to the GCOS Surface Network (GSN) and GCOS Upper-Air Network (GUAN) (2010 Update of GCOS-73). November 2010, GCOS-144, WMO/TD No. 1558.

National Weather Service Policy Directive 10-21, Feb 14, 2003, Operations and Services, Intercomparisons of Hydrometeorological Instruments and Algorithms.

National Weather Service Instruction 10-2101, October 5, 2005, Operations and Services, Intercomparison of Hydrometeorological Instruments and Algorithms. General instructions for terrestrial-based in-situ instruments and algorithm intercomparisons for the purpose of Climate Continuity.

Best Practices for GUAN Stations, Manual on the Global Observing System, WMO-No. 544, 2.10.3.17

Standard Practice for Determining Operational Comparability of Meteorological Measurements, ASTM D4430

International Station Meteorological Climate Summary, Version 4.0 September 1996. Fleet Numerical Meteorology and Oceanography Detachment, National Climatic Data Center, and USAFETAC OL-A, Asheville, North Carolina.

WMO Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8 Seventh edition 2008.

ATTACHMENT A: Historical Metadata on the NWS Legacy Radiosonde Network

Historical Metadata on the NWS Legacy Radiosonde Network

Attachment A

Prepared by
NWS Observing Systems Branch

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

Table of Contents

Figures

Tables

1.0 Introduction

In the U.S., routine radiosonde observations began in the 1940s. Prior to that, upper air observations were conducted using kites, tethered balloons, and aircraft during the 1920s and 1930s. During the early 1940s, thermistors (resistors with a resistance that varies with temperature) were introduced in order to replace glass tube type thermometers, with lithium chloride humidity elements introduced in order to replace hair hygrometers. Some significant changes were made to the radiosondes flown by the U.S. Weather Bureau between 1948 and 1950. In 1948, relative humidity values were computed using saturation values with respect to water for all temperatures. Prior to 1948, relative humidity was computed using saturation values with respect to ice for temperatures below 0ºC. In 1949, the size of the temperature element was reduced in order to decrease the instrument’s response time. In 1950, corrections were made to temperature measurements made between 400 and 10 hPa for daytime soundings whenever the solar elevation angle was greater than or equal to -2.5º. These corrections were made in order to adjust for the effects of solar radiation on the instrument.

In the 1957, the upper air observation times became 00 and 12 UTC. Prior to 1957, the observation times were 03 and 15 UTC. In 1958, the VIZ type “A” radiosonde was introduced to the upper air network. The VIZ “A” would be the workhorse radiosonde of the network for the next 32 years. Beginning in 1960, a white coating was applied to the temperature element. This eliminated the need to apply a solar correction to high altitude upper air data collected during daytime flights. As a result, the solar corrections that were applied beginning 1950 were discontinued. In 1965, the carbon humidity element was introduced. The introduction of the carbon element allowed for reporting of low relative humidity values. Earlier practice with the lithium chloride sensor was not to report low values due to poor sensor performance.

From the late 1960s through the mid 1980s, the changes to the radiosondes used in the upper air network were minimal. However, there were a few noteworthy occurrences. For example, in 1969, upper air calculations were performed by computer. Prior to 1969, upper air data calculations were completely manual. Transition from manual computations to computer based computations improved the consistency of the calculations and reduced error. In 1973, relative humidity values that ranged from 0 to 19 percent were reported as 19 percent.

There are 4 types of radiosondes that are considered VIZ-type radiosondes. In 1988, the VIZ “B” radiosonde was introduced. This was intended to replace the VIZ “A” as the primary radiosonde used through the network. In 1989, the last VIZ “A” radiosonde was flown operationally. The VIZ B2, introduced in 1997, the Sippican Microsonde MarkII (LORAN)1995, and Sippican Microsonde Mark IIA (GPS) in 2005. Prior to 1988 the VIZ radiosondes were exclusively used by NWS and since 1999 VIZ-type radiosondes have been manufactured by Sippican.

Significant changes were made to the upper air data processing software in 1991. The most noteworthy is the inclusion of 925 hPa as a mandatory level. Other changes include 20%/-

40ºC humidity cutoffs and a changing of the gravity constant as per WMO recommendation; the VIZ

Major chronological changes to VIZ radiosondes manufactured for the National Weather Service in support of the legacy network dating back to the late 1950s are included in Table 1. While the major interest of the Data Continuity Study is related to the “Large Rod Thermistor, other changes in the radiosonde design are noted which could have bearing on the measurements.

Year	**Major chronological Changes to VIZ Radiosondes used by the NWS**
1943	Ceramic temperature element and lithium chloride humidity element introduced
1944	
1945	
1946	
1947	
1948	Began computing all RH wrt water. Prior calculations were wrt ice below 0^{o}C
1949	Smaller ceramic temperature element introduced to decrease response time
1950	Solar corrections for data between 400 and 10 hPa for solar angles $\geq$ than 2.5^{o}
1951	
1952	
1953	
1954	
1955	
1956	
1957	Changed observation time from 03 and 15 UTC to 00 and 12 UTC
1958	Introduced VIZ “A” radiosonde
1959	
1960	White coated and outrigger thermistors implemented, solar corrections discontinued
1961	
1962	
1963	
1964	
1965	Carbon RH element replaced lithium chloride RH element—began reporting low RH
1966	
1967	
1968	
1969	Upper air data calculations transition from manual to computer computation
1970	
1971	
1972	
1973	Began reporting all measured RH values less than 20 percent as 19 percent
1974	
1975	
1976	
1977	
1978	
1979	

1980	Introduced Accu-Lok carbon Hygristors to VIZ radiosondes
1981	
1982	
1983	
1984	
1985	
1986	
1987	
1988	Introduced VIZ “B” radiosondes to replace VIZ “A” radiosondes
1989	Last Use of VIZ “A” radiosondes
1990	
1991	Major modifications made to the upper air data processing software: +Inclusion of 925 hPa standard level +elimination of 20 % RH and -40^{o}C dewpoint cutoffs +changing gravity constant to 9.80665
1992	
1993	
1994	
1995	Introduced Vaisala RS80 and Sippican Mark II Loran to select stations in the network
1996	
1997	VIZ “B2” introduced capacitive aneroid pressure capsule
1998	
1999	VIZ type radiosondes now manufactured by Sippican
2000	
2001	
2002	
2003	Temperature sensor changed from rod type to chip type on Sippican Mark II (Loran)
2004	
2005	Introduced Sippican Mark IIA (GPS) to select stations in the network
2006	
2007	
2008	
2009	
2010	
2011	
2012	

Table 4. VIZ Large Rod Thermistor Legacy Radiosonde Evolution for NWS Support

2.0 Data Continuity Site Historical Metadata

2.1 Tiyan, Guam (PGUM)

2.1.1 Station Description

The Guam Upper Air Station (WMO 91212, WBAN 41406) is located at latitude 13º28'39" North, longitude 144º 47'40" East at an elevation of 75.4 meters above mean sea level and is on the southern edge of AB Won Pat International. The station is located on a plateau in the central section of the island of Guam. The Guam Upper Air Station has been making routine rawinsonde observations since 1986.

Figure 16. Map of Guam Upper Air Station

2.1.2 Radiosondes Flown at Guam since 1988

The VIZ B radiosonde was flown from October 1988 through October of 1998, except for a 23-month period from November 1995 through September 1997 when the Microsonde MKII radiosonde with the rod-type temperature sensor was flown. From November 1998 through the present, the VIZ B2 has been flown at Guam. The timeline below illustrates the time periods in which each radiosonde was flown. Radiosondes flown prior to 1988 were undoubtedly the VIZ A sonde.

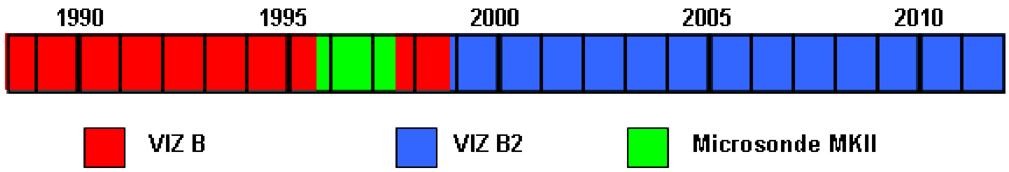


Figure 17. Timeline of radiosondes flown at Guam since 1988

2.1.3 Guam Upper Air Station Moves

The Guam Upper Air Station was moved from the old site under WMO ID 91217 to WMO ID 91212 on March 1, 1999. The old latitude was 13.55N and 144.83 E from a station elevation of 111 meters. The Guam Upper Air Station was moved southwest by 900 meters in April 2000 from latitude 13º28'59" North, longitude 144º 48'00" East to the site's present location. The relocation yielded a drop in station elevation of 2 meters from 77.4 meters.

2.2 Sterling (KLWX)

2.2.1 Station Description

The Sterling Upper Air Station (WMO 72403, WBAN 93734) is located at latitude 38º 58' 36" North, longitude 77º 29' 09" East at an elevation of 88.4 meters above mean sea level and is on the northwestern corner of Washington-Dulles International Airport. The Sterling Upper Air Station has been making routine rawinsonde observations since 1949.

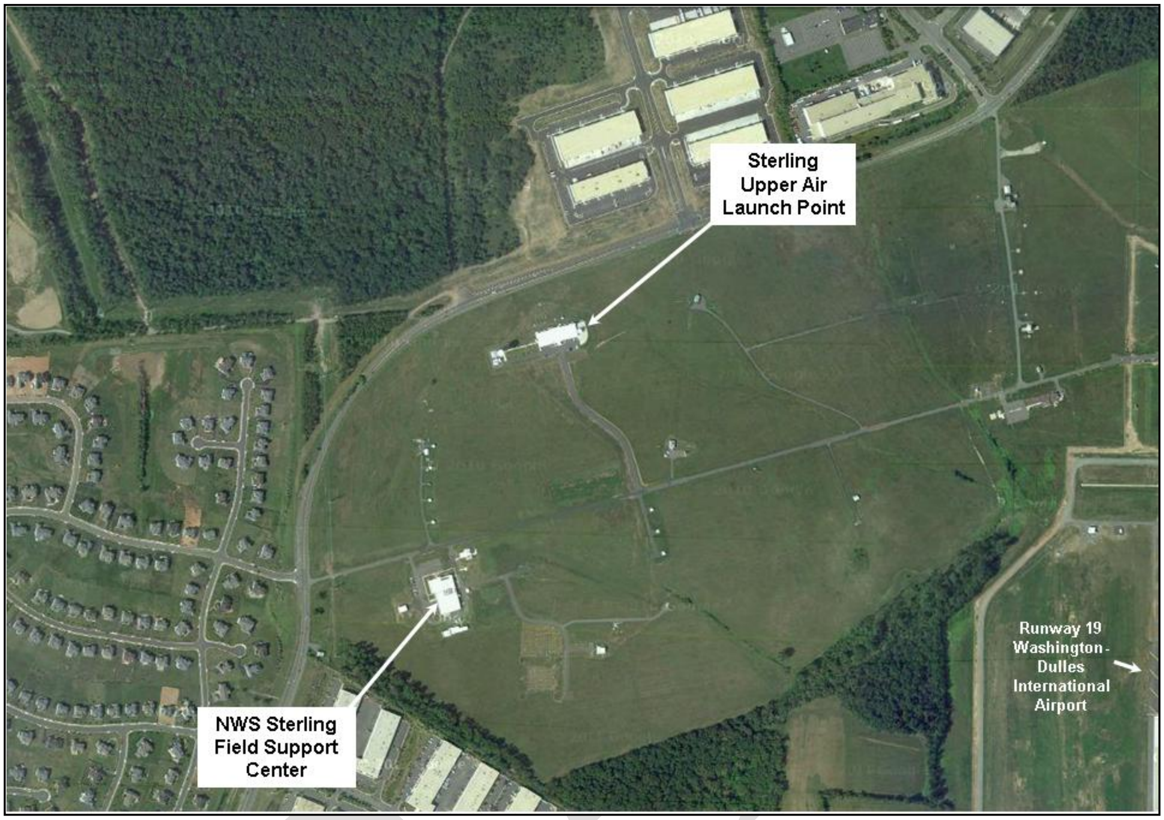


Figure 18. Map of Sterling Field Support Center

2.2.2 Radiosondes Flown at Sterling since 1988

The VIZ B radiosonde was flown from September 1988 through October of 1995. From November 1995 through July 2005, the Sterling Upper Air Station launched the Vaisala RS80 radiosonde. From August 2005 through the present, the Microsonde MKIIA GPS equipped radiosonde has been flown at Sterling. The timeline below illustrates the time periods in which each radiosonde was flown.

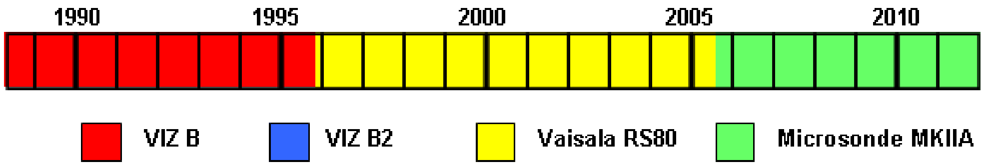


Figure 19. Timeline of radiosondes flown at Sterling since 1988

2.2.3 Sterling Upper Air Station Moves

Need move info…….10/2007, 9/2008…others...

2.3 Caribou (KCAR)

2.3.1 Station Description

The Caribou Upper Air Station (WMO 72712, WBAN 14607) is located at latitude 46º 52’ 06” North, longitude 68º 00’ 49” East at an elevation of 190.5 meters above mean sea level and is on the southeastern corner of Caribou Municipal Airport. The site is on a on a ridge in rolling country. The immediate area is suburban with the city to the south and east. The Caribou Upper Air Station has been making routine rawinsonde observations since 1946.

Figure 20. Map of Caribou Upper Air Station

2.3.2 Radiosondes Flown at Caribou since 1988

The VIZ B radiosonde was flown from October 1988 through May of 1997. From June 1997 through the present, the VIZ B2 has been flown at Caribou. The timeline below illustrates the time periods in which each radiosonde was flown. Prior to 1988 the VIZ A sonde was flown

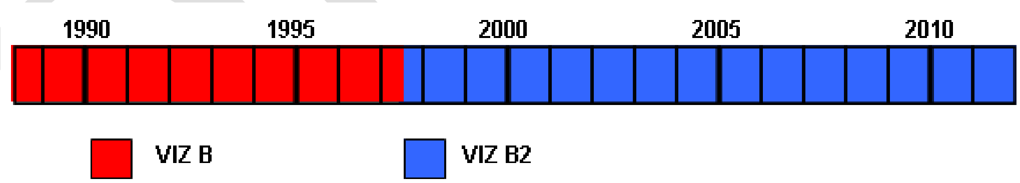


Figure 21. Timeline of radiosondes flown at Caribou since 1988

2.4 Barrow (PABR)

2.4.1 Station Description

The Barrow Upper Air station (WMO 70026, WBAN 27502) is located at latitude 71º 17’21” North, longitude 156º 47’06” W at an elevation of 11.9 meters above mean sea level and is 400 meters northeast of the end of approach runway 06 of Wiley Post-Will Roger Memorial Airport. Barrow is located on level tundra on a point of land extending into the Arctic Ocean. Open water is found to the east, west and north with tundra extending 300 miles south. The Barrow Upper Air Station has been making routine rawinsonde observations since 19XX.

Figure 22. Map of Barrow Upper Air Launch Point

2.4.2 Radiosondes Flown at Barrow since 1988

The VIZ B radiosonde was flown for over ten years from October 1988 through November of 1998, except for a two month period during August and September 1998 when the VIZ B2 radiosonde was flown. From December 1998 through the present, the VIZ B2 has been flown at Barrow. The timeline below illustrates the time periods in which each radiosonde was flown.

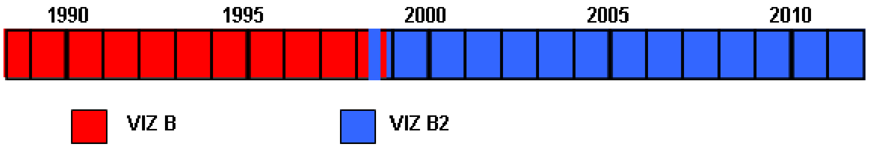


Figure 23. Timeline of radiosondes flown at Barrow since 1988

3.0 Station Histories of Radiosonde Replacement System Data Continuity Stations

3.0 Sterling, Virginia KLWX

72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1949 07 99 99 0 USING GROUND EQUIP.SCR-584 RADAR Schwartz & Govett (1992)CALL LETTERS AND WBAN NUMBER: ADW 13705	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1962 01 99 99 0 CHANGE GROUND EQUIP AN/GMD-1A to WBRT-60 Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1965 03 99 99 0 CHANGE RH SENSOR LITHIUM CHLORIDE HYGRISTOR to CARBON HYGRISTOR Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1972 02 99 99 0 CHANGE RH DUCT DUCT to REDESIGNED DUCT Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1974 04 99 99 0 CHANGE COMPUTER TIME SHARE COMPUTER to MINI-COMPUTER Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1980 12 99 99 0 CHANGE RH SENSOR CARBON HYGRISTOR to NEW CARBON HYGRISTOR Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1981 07 99 99 0 CHANGE SONDE MODEL VIZ TRANSPONDER UNSPECIFIED to VIZ ACCU-LOK UNSPECIFIED Schwartz & Govett (1992) ICAO AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1982 99 99 99 1 USING RADIAT. CORR. R1 NO RADIATION CORRECTION UK Met. O. (pers. comm.) Derived from WMO (1982)	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1982 99 99 99 1 USING SONDE MODEL I1 VIZ MK I MICROSONDE OMEGA UNSPECIFIED UK Met. O. (pers. comm.) Derived from WMO (1982)	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1986 09 99 99 0 CHANGE COMPUTER MINI-COMPUTER to MINI-ART 2 SYSTEM Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1986 99 99 99 1 USING RADIAT. CORR. R1 NO RADIATION CORRECTION UK Met. O. (pers. comm.) Derived from D MET O 1/6/1/15	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1986 99 99 99 1 USING SONDE MODEL I1 VIZ MK I MICROSONDE OMEGA UNSPECIFIED UK Met. O. (pers. comm.) Derived from D MET O 1/6/1/15	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1988 09 01 99 0 CHANGE SONDE MODEL VIZ ACCU-LOK UNSPECIFIED to VIZ B 1492-520 NWS 1680MHZ Schwartz & Govett (1992) CALL LETTERS & WBAN NUMBER:IAD 93734	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1989 12 99 99 0 CHANGE COMPUTER MINI-ART 2 SYSTEM ? to MICRO-ART SYSTEM VERSION UNSPECIFIED NOAA NWS	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1993 10 99 99 0 CHANGE DATA CUTOFF MISC. ALGORITHM to CORRECTED ALGORITHM NOAA NWS VIZ RH ALGORITHM CHANGED to REDUCE LOW BIAS AT HIGH RH.	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1993 10 99 99 0 CHANGE GRAVITY VAL. 9.8 METERS PER SECOND SQUARED to 9.80665 METERS PER SECOND SQUARED NOAA NWS	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1993 10 99 99 0 CHANGE RH ALGORITHM DEW POINT DEPRESSION = 30 C IF RH < 20% to NO CUTOFFS NOAA NWS	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1993 10 99 99 0 CHANGE RH ALGORITHM RH MISSING FOR T<-40 to NO CUTOFFS NOAA NWS	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1995 11 01 99 0 CHANGE SONDE MODEL VIZ B 1492-520 NWS 1680 MHZ to VAISALA RS80-56H NWS SOLAR/IR CORR NOAA NWS	99/1996
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4670	85	1999 02 01 99 0 CHANGE COMPUTER MICRO-ART SYSTEM VERSION UNSPECIFIED to MICRO-ART SYSTEM VERSION 2.97 NOAA NWS Temps < -90 C now recorded	11/2004
72403	72403	STERLING(WASH DULLES)	VA US	38.9833	-77.4833	86	2001 09 23 99 0 STATION MOVED NOAA NWS	01/2006
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4833	86	2005 08 01 99 0 CHANGE SONDE MODEL VAISALA RS80-67 1680 MHZ FM to SIPPICAN 1649-540 LMS5 1680 GPS NWS RRS NOAA NWS	01/2006
72403	72403	STERLING(WASH DULLES)	VA US	38.9830	-77.4833	88	2008 09 19 99 0 STATION MOVED Updated by NCAR/EOL	06/2010

Table 5. Sterling, Virginia Station History

3.1 Caribou, Maine

72712	72712	CARIBOU	ME US	46.8670	-68.0170	192	1946 07 99 99 0 CHANGE GROUND EQUIP RADIO RECEIVER 72.2 MHZ to SCR-658 OR METOX RDF Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1955 08 99 99 0 CHANGE GROUND EQUIP SCR-658 OR METOX RADIO DIRECTION FINDER to AN/GMD-1A Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1965 06 99 99 0 CHANGE RH SENSOR LITHIUM CHLORIDE HYGRISTOR to CARBON HYGRISTOR Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1965 10 99 99 0 CHANGE SONDE MODEL VIZ HYPSOMETER UNSPECIFIED to VIZ TRANSPONDER UNSPECIFIED Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1967 12 99 99 0 CHANGE SONDE MODEL VIZ TRANSPONDER UNSPECIFIED to VIZ HYPSOMETER UNSPECIFIED Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1972 02 99 99 0 CHANGE RH DUCT DUCT to REDESIGNED DUCT Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1974 08 99 99 0 CHANGE COMPUTER TIME SHARE COMPUTER to MINI-COMPUTER Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1981 09 99 99 0 CHANGE RH SENSOR CARBON HYGRISTOR to NEW CARBON HYGRISTOR Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1982 99 99 99 1 USING RADIAT. CORR. R1 NO RADIATION CORRECTION UK Met. O. (pers. comm.) Derived from WMO (1982)	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1982 99 99 99 1 USING SONDE MODEL I1 VIZ MK I MICROSONDE OMEGA UNSPECIFIED UK Met. O. (pers. comm.) Derived from WMO (1982)	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1984 05 99 99 0 CHANGE COMPUTER MINI-COMPUTER to ART AUTOMATIC RADIO-THEODOLITE SYSTEM Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1986 08 99 99 0 CHANGE COMPUTER ART AUTOMATIC RADIO-THEODOLITE SYSTEM to MINI-ART 2 SYSTEM Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607	99/1996
72712	72712	CARIBOU	ME US	46.8670	-68.0170	191	1986 99 99 99 1 USING RADIAT. CORR. R1 NO RADIATION CORRECTION UK Met. O. (pers. comm.) Derived from D MET O 1/6/1/15	99/1996

72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1986 99 99 99 1 USING SONDE MODEL I1 VIZ MK I MICROSONDE OMEGA UNSPECIFIED UK Met. O. (pers. comm.) Derived from D MET O 1/6/1/15 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1988 10 20 99 0 CHANGE SONDE MODEL VIZ HYPSOMETER UNSPECIFIED to VIZ B 1492-520 NWS 1680 MHZ Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: CAR 14607 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1989 99 99 99 1 USING SONDE MODEL I1 VIZ UNSPECIFIED UK Met. O. (pers. comm.) Derived from KITCHEN (1988) 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1990 03 99 99 0 CHANGE COMPUTER MINI-ART 2 SYSTEM ? to MICRO-ART SYSTEM VERSION UNSPECIFIED NOAA NWS 99/1996
72712 72712 CARIBOU/MUN. ME US 46.8700 -68.0200 190 ? 1992 12 99 99 0 USING SONDE MODEL I1 VIZ UNSPECIFIED Oakley (1993) 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1993 10 99 99 0 CHANGE DATA CUTOFF MISC. ALGORITHM to CORRECTED ALGORITHM NOAA NWS VIZ RH ALGORITHM CHANGED to REDUCE LOW BIAS AT HIGH RH. 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1993 10 99 99 0 CHANGE GRAVITY VAL. 9.8 METERS PER SECOND SQUARED to 9.80665 METERS PER SECOND SQUARED NOAA NWS 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1993 10 99 99 0 CHANGE RH ALGORITHM DEW POINT DEPRESSION = 30 C IF RH < 20% to NO CUTOFFS NOAA NWS 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1993 10 99 99 0 CHANGE RH ALGORITHM RH MISSING FOR T<-40 to NO CUTOFFS NOAA NWS 99/1996
72712 72712 CARIBOU ME US 46.8670 -68.0170 191 1997 06 01 99 0 CHANGE SONDE MODEL VIZ B 1492-520 NWS 1680 MHZ to VIZ/SIPPICAN B2 1492-540 NWS 1680 MHZ Updated by NCAR/EOL 06/2010

Table 6. Caribou, Maine Station History

3.2 Barrow, Alaska

70026 70026 BARROW AK US 71.3000 -156.7800 8 1959 11 99 99 0 CHANGE GROUND EQUIP SCR-658 OR METOX RDF to WBRT-57 Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: BRW 27502 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 8 1963 05 99 99 0 CHANGE RH SENSOR LITHIUM CHLORIDE HYGRISTOR to CARBON HYGRISTOR Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: BRW 27502 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 8 1972 04 99 99 0 CHANGE RH DUCT DUCT to REDESIGNED DUCT Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: BRW 27502 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1986 09 99 99 0 CHANGE COMPUTER MINI-COMPUTER to MINI-ART 2 SYSTEM Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: BRW 27502 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1988 10 01 99 0 CHANGE SONDE MODEL VIZ ACCU-LOK UNSPECIFIED to VIZ B 1492-520 NWS 1680 MHZ Schwartz & Govett (1992) CALL LETTERS AND WBAN NUMBER: BRW 27502 10/2004
70026 70026 BARROW AK US 71.3000 -156.7800 12 1989 11 99 99 0 CHANGE COMPUTER MINI-ART 2 SYSTEM ? to MICRO-ART SYSTEM VERSION UNSPECIFIED NOAA NWS 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1993 10 99 99 0 CHANGE DATA CUTOFF MISC. ALGORITHM to CORRECTED ALGORITHM NOAA NWS VIZ RH ALGORITHM CHANGED to REDUCE LOW BIAS AT HIGH RH. 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1993 10 99 99 0 CHANGE GRAVITY VAL. 9.8 METERS PER SECOND SQUARED to 9.80665 METERS PER SECOND SQUARED NOAA NWS 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1993 10 99 99 0 CHANGE RH ALGORITHM DEW POINT DEPRESSION = 30 C IF RH < 20% to NO CUTOFFS NOAA NWS 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1993 10 99 99 0 CHANGE RH ALGORITHM RH MISSING FOR T<-40 to NO CUTOFFS NOAA NWS 99/1996
70026 70026 BARROW AK US 71.3000 -156.7800 12 1998 08 09 99 0 CHANGE SONDE MODEL VIZ B 1492-520 NWS 1680 MHZ to VIZ/SIPPICAN B2 1492-540 NWS 1680 MHZ Updated by NCAR/EOL 06/2010
70026 70026 BARROW AK US 71.3000 -156.7800 12 1998 10 05 99 0 CHANGE SONDE MODEL VIZ/SIPPICAN B2 1492-540 NWS 1680 MHZ to VIZ B1492-520 NWS 1680 MHZ Updated by NCAR/EOL 06/2010
70026 70026 BARROW AK US 71.3000 -156.7800 12 1998 12 04 99 0 CHANGE SONDE MODEL VIZ B 1492-520 NWS 1680 MHZ to VIZ/SIPPICAN B2 1492-540 NWS 1680 MHZ Updated by NCAR/EOL 06/2010
70026 70026 BARROW AK US 71.3000 -156.7800 12 1999 02 01 99 0 CHANGE COMPUTER MICRO-ART SYSTEM VERSION UNSPECIFIED to MICRO-ART SYSTEM VERSION 2.97 Hammer (pers. comm.) temps. <-90 C now recorded 10/2004

Table 7. Barrow, Alaska Station History

3.3 Guam

91212 91217 GUAM/TAGUAC GQ 13.5500 144.8330 111 1986 99 99 99 1 USING SONDE MODEL I1 VIZ UNSPECIFIED UK Met. O. (pers. comm.) Derived from D MET O 1/6/1/15 /1996
91212 91217 GUAM/TAGUAC GQ 13.5500 144.8330 111 1988 10 01 99 0 CHANGE SONDE MODEL VIZ UNSPECIFIED to VIZ B 1492-520 NWS 1680 MHZ Hammer (pers. comm.) 12/2004
91212 91217 GUAM GQ 13.5500 144.8300 111 1995 11 01 99 0 CHANGE SONDE MODEL VIZ B 1492-520 NWS 1680 MHZ to VIZ MK II SERIES MICROSONDE UNSPECIFIED Hammer (pers. comm.) with rod temp sensor 12/2004
91212 91217 GUAM GQ 13.5500 144.8300 111 1997 09 99 99 0 CHANGE SONDE MODEL VIZ MK II SERIES MICROSONDE UNSPECIFIED to VIZ/SIPPICAN B2 1492-540 NWS 1680 MHZ Hammer (pers. comm.) 12/2004
91212 91212 GUAM GQ 13.4833 144.8000 75 2000 04 10 99 0 CHANGE ID NUMBER Updated by NCAR/EOL STATION MOVED 06/2010
91212 91212 GUAM GQ 13 4833 144 8000 75

Table 10. Guam Station History

RRS and MicroART File Formats
NCDC Archive

Attachment B

Prepared by
NWS Observing Systems Branch

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

Table of Contents

Tables

1.0 RRS File Formats

The following information details the RRS File Formats necessary for NCDC Archive.

1.1 RRS Data Products

The RRS software will create and transmit one or more high-resolution data products and archives, in addition to the WMO coded messages. These data products reflect the information in a flight and are disseminated for storage, analysis, and forecasting. The archives include both the raw base data entering at each interface and the refined data after NWS processing has been applied. The following high-resolution data products and archives are created:

* NCDC Archive
* Distributed Data Set (DDS)

Both data products use the same format (section 2) but are sent at different times, to different destinations.

The NCDC Archive is sent to a specific destination (NCDC); the DDS products are broadcast to the AWIPS network for all to use. Some of these products created will optionally be storable on hard media for delivery via the postal service or other similar delivery service rather than electronic transmission. All electronic transmission of data products will occur from RRS through a modem connection or a LAN connection using FTP or SFTP.

1.1.1 NCDC Archive

The high-resolution portion of the NCDC Archive product contains multiple datasets, in the **B**inary **U**niversal **F**orm for the **R**epresentation of meteorological data format (BUFR). This NCDC product contains all parameters listed in the individual datasets in section 2.

The RRS software generates this data product after flight termination as a file and optionally archives the data product to hard media. The data product file is currently sent manually via FTP specifically to NCDC, bundled (ZIP'd) with the low-resolution NCDC archive (equivalent to MicroART's). In a later build, the product file may be sent automatically to NCDC. The handling of the NCDC archive will be dependent on the station configuration (e.g., Internet bandwidth).

1.1.2 Distributed Data Set (DDS)

The DDS is a high-resolution product, containing multiple datasets, in the **B**inary **U**niversal **F**orm for the **R**epresentation of meteorological data format (BUFR), with an AWIPS WMO header. The DDS product will contain all parameters listed in the individual datasets in section 2.

The DDS is used as a means to convey subsets of the above NCDC archive data in near real-time via LDAD to AWIPS, the NWSTG, and NCEP, twice per flight. The first generation or transmittal of this product by RRS will occur once the radiosonde reaches the 70 hPa (configurable) level and will contain all data from surface up to and including the 100 hPa level. The second generation or transmittal will occur when the flight terminates and will contain all data from surface up to termination. If the flight terminates prior to 70 hPa, the transmittal will contain all data from surface to termination, resulting in a single DDS generation for the entire flight.

If a flight terminates before 400 hPa (unsuccessful flight), the DDS is not transmitted unless the operator selects the flight for product transmission (coded messages and DDS). If a flight is omitted or missed, such that the operator transmits a "no data" coded message, no DDS is transmitted.

Note: if the operator marks or unmarks certain data for exclusion, or modifies the release time or surface observation values, the second DDS generation may contain slightly different processed data values from surface to 100 hPa than are in the first generation. There is no flagging of changed values between DDS generations.

Note: in general, the DDS products are sent whenever coded messages (Parts A, B, C, D) are sent, which could be multiple times per flight, including prior to 100 hPa (if early transmission is requested by the operator). No DDS is transmitted at the time of the RADAT message transmission.

The pre-termination product(s) is distinguished from a completed flight version by a blank "Flight termination" group in the Administrative dataset. Once the flight has terminated, any DDS transmission would contain a "Flight termination" group with all fields filled in.

The "Number of archive recomputes" **ARRE** field is also used for a DDS nth-generation version number 0-99. The number will be incremented with each DDS generation and/or archive product rework generation.

1.2 Data Product Datasets Content

The high-resolution data products contain multiple datasets, in the **B**inary **U**niversal **F**orm for the **R**epresentation of meteorological data format (BUFR). The high-resolution products will contain all parameters listed in the specific individual datasets below.

* Administrative Data
* Time stamped raw PTU data (~1-2sec)
* Time stamped raw GPS data (unsmoothed) (~1sec)
* Time stamped raw GPS data (smoothed) (~1sec)
* Time stamped processed pressure, temperature, and humidity (PTU) data (1sec)
* Time stamped processed u & v winds and position data (1sec)
* Time stamped Levels data

The following seven sections describe the seven datasets of the high-resolution products. Each section describes the constituent data variables and includes their BUFR mnemonics (and any code-table prefix or suffix modifiers) in small caps, e.g. **ICLX**, for cross-reference.

1.2.1 Administrative Data (NC002019)

The following administrative data (or "meta" data) is included in each high-resolution product.

RRS-site call letters:	**DATSIG ICLX**	4-letter ICAO symbol, capitalized
WMO block number:	**WMOB**	1- 99
WMO station number:	**WMOS**	1 - 999
WBAN number:	**WBAN**	5-digit number
CCCC call letters of "Responsible WFO":		(either the RRS-site or its parent site)
	DATSIG ICLX	4-letter ICAO symbol, capitalized, part of AWIPS Identifier
XXX (FAA) call letters:	**SSTN**	3-character symbol, capitalized, part of AWIPS Identifier
Observer initials:	**OBSVR**	4-character string, space-fill
Version number of workstation software:	**SOFTV**	"##.##.##.###" (12-character string, space-fill)
Number of archive recomputes:	**ARRE**	0 - 99
Ascension number:	**RASCN**	1 - 999 (allow for 9999 extension)
Release number:	**RRLSE**	1 - 3
Release date:	**DATSIG TIMEST**	mm/dd/yyyy (UTC)
Release time:	**TIMEST**	hh:mm:ss.xx (UTC) [.01 seconds]
Release point latitude:	**CLATH**	0E to 90E N/S [0.00001E] [-90E to +90E]
Release point longitude:	**CLONH**	0E to 180E E/W [0.00001E] [-180E to +180E]
Release point elevation:	**HEIT**	-100 to 3000 meters, above MSL [Integer]
Barometer elevation:	**HBMSL**	-100 to 3000 meters, above MSL [Integer, or 0.1 m if avail.]
Radiosonde type:	**RATP**	Code Table 3-1
Radiosonde serial number:	**RSERL**	20-character string, space-fill
Radiosonde sensors used:	**PSENS**	Code Table 3-2
	TSENS	Code Table 3-3
	RHSENS	Code Table 3-4
Operating radio frequency:	**RFREQ**	403 MHz or 1680 MHZ [0.1 MHz]

Ground receiving system:		**RGRSY**	Code Table 3-5
Tracking technique:		**TTSS**	Code Table 3-6
Surface weather observation:	**DATSIG**		
Pressure:		**PRES**	700.0 to 1070.0 hPa [0.1 hPa = 10 Pa]
Temperature:		**TMDB**	-100.0 to 50.0EC [0.1EC]
Relative Humidity:		**REHU**	0.0 % to 100.0 % [0.1 %]
Wet-bulb Temp:		**TMWB**	-100.0 to 50.0EC [0.1EC]
Dewpoint Temp:		**TMDP**	-100.0 to 50.0EC [0.1EC]
Temp 12hrs ago:	**TPHR**	**TMDB**	-100.0 to 50.0EC [0.1EC] (or 99.9 if missing)
Wind direction:		**WDIR**	1E to 360E (integer)
Wind speed:		**WSPD**	[0.1 m/s]
Clouds/WX:			$N_hC_LhC_MC_H$WWWW (converted to Code tables, q.v.)
		PRWE	BUFR 0-20-003 (2 entries),
		CLAM	BUFR 0-20-011,
		CLTP	BUFR 0-20-012 (3 entries),
		HOCB	BUFR 0-20-013
Surface obs. equipment used:		**SFEQP**	5 entries (P, T, U, DP, W) from Code Table 3-7
Surface obs. equipment:		**DATSIG**	
horizontal distance:		**DIST**	0 to 500 meters [Integer]
vertical distance:		**HINC**	-250 to +250 meters [Integer]
bearing: from release point		**BEARAZ**	0E to 359.99E [0.01E]
Release point pressure correction:		**RRPPC**	-50.00 to +50.00 hPa [.01 hPa = 1 Pa]
Orientation correction, azimuth:		**ORCRAZ**	-10.00 to +10.00E [0.01E]
Orientation correction, elevation:		**ORCREL**	-10.00 to +10.00E [0.01E]
Balloon shelter type:		**BSHEL**	Code Table 3-8
Balloon manufacturer:		**BMFGR**	Code Table 3-9
Balloon type:		**BTYPE**	Code Table 3-10a
Balloon weight:		**BWHGT**	300-2500 gm
Balloon lot number:		**BLOTN**	12 characters
Balloon manufacture date:	**DATSIG**	**Y,M,D**	mm/dd/yyyy (Must be 1980 - present)
Gas type used:		**BGTYP**	Hydrogen, Helium, or Natural Gas (Code Table 3-10b)
Gas amount (nozzle lift, gm):		**BGAMT**	300 to 5000 gm (BILS ft^3 will be converted to gm)
Flight train length:		**BFTLN**	20.0 to 80.0 meters (Preflight 70 to 260 ft, converted to m)
Train regulator (y/n):		**RCONF**	Y or N (Flag Table 3-10c)
Light unit (y/n):		**RCONF**	Y or N (Flag Table 3-10c)
Parachute (y/n):		**RCONF**	Y or N (Flag Table 3-10c)
Rooftop release (y/n):		**RCONF**	Y or N (Flag Table 3-10c)
Data Corrections applied, if any:			
Pressure:		**FLPC**	Code Table 3-11
Height:			Code Table 3-12 (unused)
Temperature:		**SIRC**	Code Table 3-13
Relative Humidity:			Code Table 3-14 (unused)
Dewpoint:			Code Table 3-15 (unused)
Wind:			Code Table 3-16 (unused)
Flight termination:		**DATSIG**	

Duration:		**TPMI,TPSC**	hh:mm:ss
Date:		**TIMEST**	mm/dd/yyyy (UTC)
Time:		**TIMEST**	hh:mm:ss (UTC)
Latitude:		**CLATH**	0E to 90E N/S [0.00001E] [-90E to +90E]
Longitude:		**CLONH**	0E to 180E E/W [0.00001E] [-180E to +180E]
Geopotential Height:		**GPH10**	-50 to +45,000 std. geopot. meters, above MSL
Pressure:	**FLPC**	**PRLC**	0.01 hPa to 1070.00 hPa [0.01 hPa = 1 Pa]
Temperature:	**SIRC**	**TMDB**	-100.00EC to +50.00EC [0.01EC]
RH:		**REHU**	0.0 % to 100.0 % [0.1 %]
Reason for Wind Processing Term:	**LEVSIG**	**RTERM**	Code Table 3-17
Reason for Flight Term:	**LEVSIG**	**RTERM**	Code Table 3-17

1.2.2 Time stamped raw PTU data (NC002020)

This radiosonde data may represent an average of several values over a period sample (vendor specific), thus allowing for the removal of random and systematic instrument noise. This data is not interpolated or smoothed, and is reported every 1 to 2 seconds of the flight (vendor specific).

Time Stamp:	**DATSIG**	**TIMEST**	mm/dd/yyyy (UTC), hh:mm:ss.xx (UTC) [.01 seconds]
Pressure:	**FLPC**	**PRLC**	0.01 hPa to 1070.00 hPa [0.01 hPa = 1 Pa], but permit extended range for erroneous P (e.g., 0.00 to 1310.73 hPa)
Temperature:	**SIRC**	**TMDB**	-100.00EC to +50.00EC [0.01EC], but permit extended range for erroneous T (e.g., -273.16E to 382.19E)
Relative Humidity:		**RAWHU**	0.0 % to 100.0 % [0.1 %], but permit extended range for erroneous RH values (e.g., -100.0 % to +309.5 %)
P Quality Indicator:		**PCCF**	Integer (0 to 100, vendor-generated in the SPS)
T Quality Indicator:		**PCCF**	Integer (0 to 100, vendor-generated in the SPS)
U Quality Indicator:		**PCCF**	Integer (0 to 100, vendor-generated in the SPS)
P Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
T Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
U Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)

1.2.3 Time stamped raw GPS "unsmoothed radiosonde" data (NC002021)

This radiosonde data may represent an average of several values over a period sample (vendor specific), thus allowing for the removal of random and systematic instrument noise. This data is not smoothed, and is reported every 1 to 2 seconds of the flight (vendor specific).

Time Stamp:	**DATSIG**	**TIMEST**	mm/dd/yyyy (UTC), hh:mm:ss.xx (UTC) [.01 seconds]
GPS Latitude:		**CLATH**	0E to 90E N/S [0.00001E] [-90E to +90E]
GPS Longitude:		**CLONH**	0E to 180E E/W [0.00001E] [-180E to +180E]

GPS (geometric) height		**HEIT**	-50 m to +45,000 m, above MSL [Integer]
GPS u wind component		**UWND**	-200.0 to 200.0 m/s [0.1 m/s]
GPS v wind component		**VWND**	-200.0 to 200.0 m/s [0.1 m/s]
GPS velocity & position Quality Indicator		**PCCF**	Integer (0 to 100, vendor-generated in the SPS)
Lat Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
Lon Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$H_{geometric}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
u Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
v Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)

1.2.4 Time stamped raw GPS "smoothed wind" data (NC002022)

This radiosonde data may represent an average of several values over a period sample (vendor specific), thus allowing for the removal of random and systematic instrument noise. This data is smoothed in the SPS to remove the effects of erratic and pendular motion, and is reported every 1 to 2 seconds of the flight (vendor specific).

Time Stamp:	**DATSIG**	**TIMEST**	mm/dd/yyyy (UTC), hh:mm:ss.xx (UTC) [.01 seconds]
GPS Latitude:		**CLATH**	0E to 90E N/S [0.00001E] [-90E to +90E]
GPS Longitude:		**CLONH**	0E to 180E E/W [0.00001E] [-180E to +180E]
GPS (geometric) height		**HEIT**	-50 m to +45,000 m, above MSL [Integer]
GPS u wind component		**UWND**	-200.0 to 200.0 m/s [0.1 m/s]
GPS v wind component		**VWND**	-200.0 to 200.0 m/s [0.1 m/s]
GPS velocity & position Quality Indicator		**PCCF**	Integer (0 to 100, vendor-generated in the SPS)
Lat Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
Lon Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$H_{geometric}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
u Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
v Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)

1.2.5 Time stamped processed pressure, temperature, and humidity (PTU) data (NC002023)

This processed data is arrived at by applying normalization, correction, smoothing, outlier removal, and data plausibility checks to the raw PTU data provided by the radiosonde. This data is reported at the normalization interval --- once a second.

Time Stamp:	**DATSIG**	**TIMEST**	mm/dd/yyyy (UTC), hh:mm:ss.xx (UTC) [.01 seconds]
Corrected Pressure:	**FLPC**	**PRLC**	0.01 hPa to 1070.00 hPa [0.01 hPa = 1 Pa]
Smoothed Pressure:	**FLPC**	**PRLC**	0.01 hPa to 1070.00 hPa [0.01 hPa = 1 Pa]

Uncorrected Temperature:	**SIRC**	**TMDB**	-100.00EC to +50.00EC [0.01EC] (for NCEP)
Corrected Temperature:	**SIRC**	**TMDB**	-100.00EC to +50.00EC [0.01EC]
Corrected Relative Humidity:		**REHU**	0.0 % to 100.0 % [0.1 %]
Derived Dewpoint Temperature:		**TMDP**	-135.00EC to +50.00EC [0.01EC]
Derived Geopotential Height:		**GPH10**	-50 m to +45,000 std. geopot. m, above MSL [Integer]

$P_{corrected}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$P_{smoothed}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$T_{uncorrected}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$T_{corrected}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
RH Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
Dewpoint Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$H_{geopotential}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)

1.2.6 Time stamped processed u & v winds and position data (NC002024)

This processed data is arrived at by applying normalization, outlier removal, and data plausibility checks to the raw GPS "smoothed wind" data provided by the radiosonde. This data is reported at the normalization interval --- once a second. Note that this GPS-derived wind and position data may drop out at times during the flight, but the pressure-derived geopotential height may still be available, and vice versa.

Time Stamp:	**DATSIG**	**TIMEST**	mm/dd/yyyy (UTC), hh:mm:ss.xx (UTC) [.01 seconds]

Latitude:	**CLATH**	0E to 90E N/S [0.00001E] [-90E to +90E]
Longitude:	**CLONH**	0E to 180E E/W [0.00001E] [-180E to +180E]
Geometric height:	**HEIT**	-50 m to +45,000 m, above MSL [Integer]
u wind component:	**UWND**	-200.0 to 200.0 m/s [0.1 m/s]
v wind component:	**VWND**	-200.0 to 200.0 m/s [0.1 m/s]

Lat Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
Lon Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
$H_{geometric}$ Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
u Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)
v Quality-Control Flag:	**MAQC**	**QCCHEK**	Integer (Code Table 3-19, 3-20)

1.2.7 Time stamped Levels data (NC002025)

This data represents the Mandatory, Significant, and other special winds and PTU levels selected from the Processed Data Set (Processed PTU and Processed Winds data).

The following parameters will be included for each level:

Time Stamp:	**DATSIG**	**TIMEST**	mm/dd/yyyy (UTC), hh:mm:ss.xx (UTC) [.01 seconds]

Pressure:	**FLPC**	**PRLC**	0.01 hPa to 1070.00 hPa [0.01 hPa = 1 Pa]
Temperature:	**SIRC**	**TMDB**	-100.0 to 50.0EC [0.1EC]
Relative Humidity:	**RENU**		0.0 % to 100.0 % [0.1 %]
Dewpoint Temperature:	**TMDP**		-135.0 to 50.0EC [0.1EC]
Geopotential Height:	**GPH10**		-50 m to +45,000 std. geopot. m, above MSL [Integer]
Geometric Height:	**HGHT**		-50 m to +45,000 m, above MSL [Integer]
Wind direction:		**WDIR**	1E to 360E (integer)
Wind speed:		**WSPD**	0.0 to 300.0 [0.1 m/s]
Vertical Sounding Flag:	**LEVSIG**		Code Table 3-18, indicating Met/Wind Level type/signif.

1.3 Tables

Code	Meaning
0-50	Defined or Reserved
51	VIZ-B2 (USA)
52	Vaisala RS80-57H
53-86	Defined or Reserved
87	Sippican Mark IIA with chip thermistor, pressure
88-254	Defined or Reserved
255	Missing value

Table 11. Radiosonde Type (existing 0-02-011, C-2, RATP)

Code	Meaning
0	Capacitance aneroid
1	Derived from GPS
2	Resistive strain gauge
3-29	Reserved
30	Other
31	Missing value

Table 12. Type of pressure sensor (new 0-02-095, PSENS)

Code	Meaning
0	Rod thermistor
1	Bead thermistor
2	Capacitance bead
3-29	Reserved
30	Other
31	Missing value

Table 13. Type of temperature sensor (new 0-02-096, TSENS)

Code	Meaning
0	VIZ Mark II Carbon Hygristor
1	VIZ B2 Hygristor
2	Vaisala A-Humicap
3	Vaisala H-Humicap
4	Capacitance sensor
5	Vaisala RS90
6	Sippican Mark IIA Carbon Hygristor
7-29	Reserved
30	Other
31	Missing value

Table 14. Type of humidity sensor (new 0-02-097, RHSENS)

Code	Meaning
0	TRS-2000
1	IMS-1500C
2-61	Reserved
62	Other
63	Missing value

Table 15. Radiosonde ground receiving system (new 0-02-066, RGRSY)

Code	Meaning
0	No windfinding
1	Automatic with auxiliary optical direction finding
2	Automatic with auxiliary radio direction finding
3	Automatic with auxiliary ranging
4	Not used
5	Automatic with multiple VLF-Omega signals
6	Automatic with cross chain Loran-C
7	Automatic with auxiliary wind profiler
8	Automatic satellite navigation (GPS)
9-18	Reserved
19	Tracking technique not specified
20-126	ASAP technique/status entries
127	Missing value

Table 16. Tracking technique (existing 0-02-014, C-7, TT SS)

Code	Meaning
0	PDB
1	RSOIS
2	ASOS
3	Psychrometer
4	F420
5-29	Reserved
30	Other
31	Missing value

Table 17. Type of surface observing equipment (new 0-02-115, SFEQP)

Code	Meaning
0	High bay
1	Low bay
2	BILS
3	Roof-top BILS
4-13	Reserved
14	Other
15	Missing value

Table 18. Type of balloon shelter (new 0-02-083, BSHEL)

Code	Meaning
0	Kaysam
1	Totex
2	KKS
3-61	Reserved
62	Other
63	Missing value

Table 19. Balloon manufacturer (new 0-02-080, BMFGR)

Code	Meaning
0	GP26
1	GP28
2	GP30
3	HM26
4	HM28
5	HM30
6	SV16
7-29	Reserved

30	Other
31	Missing value

Table 20. Type of balloon (new 0-02-081, BTYPE)

Code	Meaning
0	Hydrogen
1	Helium
2	Natural Gas
3-14	Reserved
15	Missing value

Table 21. Type of gas used in balloon (new 0-02-084, BGTYP)

Bit	Meaning
1	Train regulator
2	Light unit
3	Parachute
4	Rooftop release
All 5	Missing value

Table 22. Radiosonde configuration (new 0-02-016, RCONF)

Bit	Meaning
1	Smoothed
2	Baseline adjusted
3	Normalized time interval
4	Outlier checked
5	Plausibility checked
6	Consistency checked
7	Interpolated
All 8	Missing value

Table 23. Pressure Corrections (new 0-25-069, FLPC)

Code	Meaning
TBD	TBD

Table 24. Height Corrections (unused, undefined)

Code	Meaning
0	No correction
1-3	CIMO
4	Solar and infrared corrected by radiosonde system
5	Solar corrected by radiosonde system
6-7	corrected as specified by country
8-14	Reserved
15	Missing value

Table 25. Temperature Corrections (existing 0-02-013, SIRC)

Code	Meaning
TBD	TBD

Table 26. Relative Humidity Corrections (unused, undefined)

Code	Meaning
TBD	TBD

Table 27. Dewpoint Corrections (unused, undefined)

Code	Meaning
TBD	TBD

Table 28. Wind Corrections (unused, undefined)

Code	Meaning
0	Reserved
1	Balloon burst
2	Balloon forced down by icing
3	Leaking or floating balloon
4	Weak or fading signal
5	Battery failure
6	Ground equipment failure
7	Signal interference
8	Radiosonde failure
9	Excessive missing data frames
10	Reserved
11	Excessive missing temperature
12	Excessive missing pressure
13	User terminated

14-29	Reserved
30	Other
31	Missing value

Table 29. Reason for termination (new 0-35-035, RTERM)

Code	Meaning
0 *	High resolution data sample
1	Within 20 hPa of surface
2	Pressure less than 10 hPa (i.e., 9, 8, 7, etc.) when no other reason applies
3	Base pressure level for stability index
4 *	Begin doubtful temperature, height data
5 *	Begin missing data (all elements)
6	Begin missing RH data
7	Begin missing temperature data
8	Highest level reached before balloon descent because of icing or turbulence
9 *	End doubtful temperature, height data
10 *	End missing data (all elements)
11	End missing RH data
12	End missing temperature data
13	Zero degrees C crossing(s) for RADAT
14	Standard pressure level
15	Operator added level
16	Operator deleted level
17	Balloon re-ascended beyond previous highest ascent level
18	Significant RH level (per WMO criteria)
19 *	RH level selection terminated
20	Surface level
21	Significant temperature level (per WMO criteria)
22 *	Mandatory temperature level
23	Flight termination level
24	Tropopause(s)
25 *	Aircraft report
26 *	Interpolated (generated) level
27 *	Mandatory wind level
28	Significant wind level
29	Maximum wind level
30	Incremental wind level (fixed regional)
31 *	Incremental height level (generated)
32	Wind termination level

33	Pressure 100 to 110 hPa, when no other reason applies
34-39 *	Reserved
40 *	Significant thermodynamic level (inversion)
41 *	Significant RH level (per NCDC criteria)
42 *	Significant temperature level (per NCDC)
43	Begin missing wind data
44	End missing wind data
45-61 *	Reserved
62 *	Other
63 *	Missing value

Table 30. RRS flight level significance (new 0-08-040, LEVSIG)
* Not currently used in RRS

Code	Meaning	RRS
0	Automatic QC passed; not manually checked	0
1	Automatic QC passed; manual QC passed	
2	Automatic QC passed; manual QC deleted	4
3	Automatic QC failed; not manually checked	2
4	Automatic QC failed; manual QC deleted	6
5	Automatic QC failed; manual QC re-inserted	
6	Automatic QC questionable; not manually checked	1
7	Automatic QC questionable; manual QC deleted	5
8	Manual QC failed	
9-14	Reserved	
15	Missing value	3,7

Table 31. RRS Data Quality-Check Mark, maps to Manual/Automatic Quality Control (existing 0-33-035, `MAQC`)

Code	Meaning
0	Passed all checks
1	Missing-data check
2	Descending/reascending balloon check
3	Data plausibility check (above limits)
4	Data plausibility check (below limits)
5	Superadiabatic lapse rate check
6	Limiting angles check
7	Ascension rate check
8	Excessive change from previous flight
9	Balloon overhead check
10	Wind speed check
11	Wind direction check

12	Dependency check
13	Data valid but modified
14	Data outlier check
15-62	Reserved
63	Missing value

Table 32. RRS Data Quality-Check Indicator (new 0-33-015, QCCHEK)

Supplemental Table used

Code	Meaning
0	parent site
1	observation site
2	Balloon manufacture date
3	Balloon launch point
4	Surface observation
5	Surface observation displacement from launch point
6	Flight level observation
7	Flight level termination point
8-30	Reserved
31	Missing value

Table 33. RRS data significance (new 0-08-041, DATSIG)

2.0 MicroART File Formats

The following information details the MicroART File Formats necessary for NCDC Archive.

2.1 Background

This document describes the data format that the National Weather Service (NWS) uses to deliver radiosonde observations to the National Climatic Data Center (NCDC). The National Weather Service radiosonde ground system equipment formats each sounding, intended for relay to the NCDC, as two files, an identification file and a sounding data file. The Identification file has one 160 character record containing date and time of flight, station and equipment metadata, and surface weather parameters at the time of balloon release. The file naming convention for Identification files is H plus ascension number from the first of the year. The Data File contains a variable number of 80 character records, each containing data for one reported level. Data records contain flight ascension number, elapse time since release, layer type, observed elements, and data quality indicators. The naming convention for Data Files is T plus ascension number from first of the year.

NWS field personnel copy data files from the upper air pc to another pc with internet access via diskette or file transfer cable and software, and transmit to NCDC via File Transfer Protocol (FTP) or e-mail attachment at the end of each month. The NCDC transcribes all incoming flight files to the NCDC upper-air quality control system to produce a digital archive. The NCDC upper-air data archive contains all original data and quality indicators generated by NCDC automated and interactive quality control process.

Identification File

```
RECORD      ELEMENT
POSITION    NAME        CODE DEFINITIONS AND REMARKS
==============================================================
  1         STN-IND     STATION NUMBER INDICATOR - This field
                        contains an indicator specifying the
type
                        of station number in the next field:

0 = WBAN NUMBER
1 = WMO NUMBER
2 = AIR FORCE AUGMENTED WMO NUMBER
3 = SHIP CALL SIGN
4 = MOBILE UNIT CALL SIGN
---------------------------------------------------------------

  2-9       STN NUM     STATION NUMBER - The number assigned to
                        the station according to the numbering
                        system specified in record position 1.
                        Numbers should be right justified with
                        leading blanks, ship CALL signs left
                        justified with trailing blanks.  NWS
                        stations must enter WBAN number.  If the
                        number is missing, enter "00000000".
---------------------------------------------------------------
 10-14      LAT         LATITUDE - The station latitude in
                        degrees and minutes.  The last character
                        is "N" or "S" as appropriate.  When
                        unknown, this field contains "9999N".
---------------------------------------------------------------
 15-20      LONG        LONGITUDE - The station longitude in
                        degrees and minutes.  The last character
                        is "E" or "W" as appropriate.  When
                        unknown, this field contains "99999E".
---------------------------------------------------------------
 21-24      ELEV        ELEVATION - The height of the launch
site
                        in whole meters.
---------------------------------------------------------------
 25-28      YEAR        YEAR - The 4-digit year expressed at the
                        hour of observation (UTC).
---------------------------------------------------------------
 29-30      MONTH       MONTH - The numeric month expressed at
```

		the hour of observation (UTC).
31-32	DAY	DAY - The numeric day expressed at the hour of observation (UTC).
33-34	HOUR	HOUR - The hour (24-hour clock) of observation (UTC). For synoptic hours (H=00, 06, 12, 18) the hour of observation will be H whenever the actual release time is H-30 to H+29. For example, the synoptic hour will be entered as 12 when the actual release is from 1130 to 1229 UTC. For regular synoptic observations the actual release should occur as close as possible to H-30. For non-synoptic hours, the hour of observation will be the nearest whole hour, H-30 to H+29 (e.g. the hour is entered as 10 when release is 0930 to 1029 UTC).
35-38	RELSE TIME	TIME OF ACTUAL RELEASE - The hour and minute UTC (24-hour clock) of the actual release time.
39-42	ASCN NUM	ASCENSION NUMBER - The ascension number for the year. The first release on or after Jan 1 will be numbered 0001. Ascension numbers are right-justified with leading zeros.
43-46	OBSVR INIT	OBSERVER INITIALS - The initials of the first and last name of the observer.
47-49	DTA RDC SYS	DATA REDUCTION SYSTEM - The type of data reduction system used at the site.

001 = MANUAL
002 = TIME-SHARE
003 = NOVA MINI COMPUTER

004 = MINI-ART
005 = MICRO-ART
007 = MARWIN, MRS
008 = MSS
009 = LAMS
010 = ASAP
011 = MV 7800
012 = AIR MET **RESEARCH** RAWIN SYSTEM
013 = VIZ **W-9000** Meteorological Processing System (DOS based)
014 = RRS
018 = **ATIR**
019 = InterMet 1500
020 = WIN9000 (Software for LMG6 System) Windows based

50-52 SONDE MAN SONDE MANUFACTURER - The manufacturer of the Sonde in use.

001 = VIZ
002 = VAISALA
003 = SPACEDATA
004 = AIR
005 = ATIR
006 = Sippican
007 = InterMet
008 = Lockheed Martin Sippican (LMS)

53-55 SONDE TYP SONDE TYPE - The type of Sonde used at the station.

001 = VIZ J031
002 = VIZ ACCU-LOC
003 = VIZ A
004 = VIZ B
005 = VIZ MSS
006 = SPACEDATA-TRANSPONDER
007 = SPACEDATA-ARTSONDE
008 = SPACEDATA-MSS
009 = VAISALA RS80(version unknown)
010 = VIZ B mod. 1492-520 (1680/403MHz)- TRANSPONDER
011 = AIR INTELLISONDE
012 = VIZ Mark II MICROSONDE
013 = VIZ C mod. 1492-530 (1680 MHz) Accu Lok 014-019 reserved
020 = VAISALA RS80-15N Navy MRS (OMEGA Navaid windfinding)
021 = VAISALA RS80-15P (OMEGA Navaid windfinding)

```
022 = VAISALA RS80-15L (Loran-C Navaid windfinding)
 ...
038 = VAISALA RS80-56 (Radio Direction Finding(RDF), 1680 MHz)-
      pressure cell
039 = VAISALA RS80-57 (RDF, 1680 MHz)
040-044 reserved
045 = Sippican HRFE
046 = Sippican LRFE
 ...
489 = VIZ B-2 (RDF, 1680 MHz) capacitance aneroid pressure
sensor
 ...
```

500 = Mark IIA Sippican GPS 1680 MHz with aneroid pressure cell and carbon element RH
501 = InterMet GPS
502 = LMS6 Lockheed Martin Sippican 403 MHZ GPS radiosonde with capacitive RH sensor and derived pressure from GPS height

```
---------------------------------------------------------------
  56        SON/BAR     SONDE/BAROSWITCH NUMBER INDICATOR - An
            IND         indicator specifying the type of number
                        in the next field.

0 = SONDE SERIAL NUMBER
1 = BAROSWITCH NUMBER
---------------------------------------------------------------
 57-76     SON/BAR     SONDE/BAROSWITCH - The Sonde serial
            NUM         number or the Baroswitch number right
                        justified in the field, with leading
                        blanks .  This "number" probably will
                        include non-numeric characters.
---------------------------------------------------------------
 77-79      HUM TYP    HUMIDITY TYPE - Type of humidity element
                        used in the system.

001 = Lithium Chloride Hygristor
002 = 1960's Carbon Hygristor
003 = 1980's Carbon Hygristor
004 = Humicap
005 = H-Humicap
006 = VIZ Mark II carbon hygristor
```

007 = Capacitance sensor
008 = Sippican Mark IIA Carbon Hygristor
009 = LMS6 thin film capacitance humidity sensor

```
---------------------------------------------------------------
```

```
 80-82      TEMP TYP    TEMPERATURE TYPE - Type of temperature
                        element used in the system.

001 = Rod Thermistor
002 = Bead Thermistor
003 = Chip Thermistor
004 = Capacitive Bead
---------------------------------------------------------------
 83-85      PRESS TYP   PRESSURE TYPE - Type of pressure element
                        used in the system.

001 = Baroswitch
002 = Transducer - oven controlled
003 = Transducer - non-oven controlled
004 = Derived (Transponder)
005 = Capacitive Aneroid
006 = Resistive strain gauge
007 = Pressure derived from differential GPS geometric height
```

86-88	TRK TYP	TRACKING TYPE - The type of tracking system.

001 = 72-2	010 = LORAN
002 = SCR-658	011 = ART-1
003 = WBRT-57	012 = ART-1R
004 = WBRT-60	013 = ART-2
005 = GMD-1	014 = ART-2R
006 = GMD-1A	015 = MDS
007 = GMD-1B	016 = MSS RANGING
008 = GMD-5	017 = RADIO THEODOLITE
009 = OMEGA	**018 = Global Positioning System (GPS)**

89	TRNSP	TRANSPONDER - is a transponder used.

0 = No
1 = Yes

90-92	BAL MAN	BALLOON MANUFACTURER - The manufacturer of the balloon.

001 = KAYSAM
002 = WEATHERTRONICS
003 = KKS
004 = Totex
999 = Other

93-96	BAL WGT/ TYP	BALLOON WEIGHT/TYPE - Nominal weight of the balloon in grams or balloon type as follows:

0001 = GP26
0002 = GP28
0003 = GP30
0004 = HM26
0005 = HM28
0006 = HM30
0007 = SV16
9999 = Other

97-98	BAL AGE	BALLOON AGE - Age of the balloon in months.

```
  99        TRN REG     TRAIN REGULATOR - Was a train regulator
                        used
N = No
Y = Yes
```

```
  100       PBL LGT     PIBAL LIGHT - Was a PIBAL light used

N = No
Y = Yes
```

```
  101       PBL TYP     PIBAL TYPE - PIBAL wind equipment type
                        according to WMO Code Table 0265.

0 = Pressure instrument associated with wind-measuring equipment
1 = Optical Theodolite
2 = Radio Theodolite
3 = Radar
```

8 = Satellite Navigation (or GPS)

```
102-103     REASON      REASON FOR TERMINATION - Reason for
            TERMN       termination of the flight:

01 = Balloon burst
02 = Balloon forced down by icing
03 = Leaking or floating balloon
04 = Weak or fading signal
05 = Battery failure
06 = Ground equipment failure
07 = Signal interference
08 = Radiosonde failure
09 = Excessive missing data
10 = Other
```

```
  104       NUM RCP     RECOMPUTES - The number of times this
                        flight has been recomputed.
```

105-113 CLOUDS-WX CLOUDS AND WEATHER - The observation of the clouds and weather at the time of release. The field is of the form $N_hC_LhC_MC_H$WWWW, where:

N_h = The amount of low or mid-level clouds present according to WMO Code Table 2700.

0 = 0 okta (tenths)
1 = 1 okta (1/10) or less, but not zero
2 = 2 oktas (2/10-3/10)
3 = 3 oktas (4/10)
4 = 4 oktas (5/10)
5 = 5 oktas (6/10)
6 = 6 oktas (7/10-8/10)
7 = 7 oktas (9/10) or more, but not overcast
8 = 8 oktas (10/10)
9 = Sky is obscured by fog and/or other meteorological phenomena
- = Cloud cover is indiscernible for reason other than "9" or observation not made. The WMO code figure "/" must be converted to "-".

C_L,C_M,C_H = The cloud type according to WMO Code Tables 0509, 0513, and 0515. Code figure "/" must be converted to "-".

h = WMO Code Table 1600 for the height above ground of the base of the lowest cloud seen. Code figure "/" must be converted to "-".

WW = Present weather according to WMO Code Table 4677. Up to two types of present weather or obscurations may be entered. If present weather is not observed,enter "////" in this field (WWWW).

114-116 SFCWND DIR SURFACE WIND DIRECTION - The direction of the surface wind at time of release in whole degrees.

117-119 SFCWND SPD SURFACE WIND SPEED - The speed of the surface wind at time of release in
meters
per second to the nearest 0.1 meter per second. Do not enter the decimal point; 12.3 meters per second = 123.

```
-----------------------------------------------------------------
120-122      WIND AVE     WIND AVERAGING INTERVAL - The interval
               INT        of time or height over which the wind is
                          derived.

000 = None (instantaneous)
001 = Two mins. to 14km (MSL), four mins. above 14km (MSL).
      (Pre-1990 FMH  Standard, NWS)
002 = Post-1989 FMH Standard
003 = 20 seconds to 15K ft., 60 seconds above 15K ft.
004 = 30 seconds up to 2500m AGL,
      45 seconds up to 5000m AGL,
      60 seconds up to 7500m AGL,
      75 seconds up to 10 km AGL,
      90 seconds up to 15 km AGL,
     105 seconds up to 20 km AGL,
     120 seconds above 20 km AGL.
005 = Four mins. for the entire flight
006 = Two  mins. for the entire flight
007 = Variable
008 = One Minute smoothing
-----------------------------------------------------------------
123-134      CORTYP       TYPE OF CORRECTION - The type of
                          correction applied to individual data
                          elements by automated systems or
                          observers.
-----------------------------------------------------------------
123-124      CORTYP-P     PRESSURE CORRECTIONS

00 = No correction applied
01 = NASA temperature correction
02 = EMCWF temperature correction
...
...
88 = Unknown
-----------------------------------------------------------------
125-126      CORTYPE-Z    HEIGHT CORRECTIONS

00 = No correction applied
01 = Local gravity correction
02 = Standard gravity correction
...
...
88 = Unknown
```

```
----------------------------------------------------------------
127-128     CORTYP-T    TEMPERATURE CORRECTIONS

00 = No correction applied
01 = NASA radiation correction
02 = EMCWF radiation correction
03 = NMC radiation correction
04 = Vaisala RSN-93 solar and infrared radiation correction
...
...
11 = NASA lag correction
12 = EMCWF lag correction
13 = NMC lag correction
...
...
21 = NASA radiation and lag correction
22 = EMCWF radiation and lag correction
23 = NMC radiation and lag correction
...
...
88 = Unknown
89 = Sippican W-9000 Solar Correction
90 = Sippican Solar and Infrared
91 = InterMet Solar and Infrared
92 = LMS WIN9000 Solar Correction
----------------------------------------------------------------
129-130     CORTYP-H    HUMIDITY CORRECTIONS

00 = No corrections applied
01 = NASA lag correction
02 = EMCWF lag correction
03 = NMC lag correction
...
...
88 = Unknown
----------------------------------------------------------------
131-132     CORTYP-TD   DEW POINT CORRECTIONS

00 = No corrections applied
01 = NASA lag correction
02 = EMCWF lag correction
03 = NMC lag correction
...
...
```

88 = Unknown

133-134   CORTYP-W   WIND CORRECTIONS

00 = No corrections applied
01 = Elevation angle correction
02 = Ranging correction
...
...
88 = Unknown

NOTE: At this writing, the types of corrections which may be applied to the data have not been determined. Input from various agencies will be used to develop initial codes and correction types.

135-144	SOFT VER	SOFTWARE VERSION - The version of software in use with the specified recording system. Enter the software version left-justified with trailing blanks.
145-160	RES FLD	RESERVED FIELD - Leave blank

DATA RECORD

RECORD POSITION	ELEMENT NAME	CODE DEFINITIONS AND REMARKS
1-4	ASCN NUM	ASCENSION NUMBER - The ascension number for the year. The first release on or after Jan 1 will be numbered 0001.
5-9	ELPSD TIME	ELAPSED TIME - The time in minutes and seconds (mmmss) since the actual release time.
10-15	PRESS	PRESSURE - Atmospheric pressure at the current level in hundredths of hectopascals (0.01 millibars).
16-20	HGT	HEIGHT - Geopotential height of the pressure level in whole geopotential meters. (MSL)
21-24	TEMP	TEMPERATURE - Dry-bulb temperature to the nearest 0.1 degree Celsius.
25-28	REL HUM	RELATIVE HUMIDITY - The relative humidity to the nearest 0.1 percent.
29-31	DPDP	DEW POINT DEPRESSION - The dew-point depression to the nearest 0.1 degree Celsius
32-34	WIND DIR	WIND DIRECTION - The wind direction to the nearest whole degree.
35-38	WND SPD	WIND SPEED - Wind speed to the nearest 0.1 meter per second.
39-40	TYP LEVEL	TYPE OF LEVEL - The reason for selection of the level:

00 = High resolution data sample
01 = Within 20 hectopascals (mb) of the surface

02 = Pressure less than 10 hectopascals (mb)
03 = Base pressure level for stability index
04 = Begin doubtful temperature, altitude data
05 = Begin missing data (all elements)
06 = Begin missing relative humidity data
07 = Begin missing temperature data
08 = Highest level reached before balloon descent because of icing or turbulence.
09 = End doubtful temperature, altitude data
10 = End missing data (all elements)
11 = End missing relative humidity data
12 = End missing temperature data
13 = Zero degree crossing for the RADAT
14 = Mandatory pressure level
15 = Operator added level
16 = Operator deleted level
17 = Balloon re-ascended beyond previous highest level
18 = Significant relative humidity level
19 = Relative humidity level selection terminated
20 = Surface level
21 = Significant temperature level
22 = Mandatory temperature level
23 = Flight termination level
24 = Tropopause
25 = Aircraft report
26 = Interpolated (generated) level
27 = Mandatory wind level
28 = Significant wind level
29 = Maximum wind level
30 = Incremental wind level (e.g., 1-minute, fixed regional)
31 = Incremental height level (generated
32 = Wind termination level
33 = Pressure 100 to 110 hectopascals, when no other reason applies.
...
...
40 = Significant thermodynamoic level (reason for selection unknown)
41 = Significant relative humidity level, using NCDC criteria.
42 = Significant temperature level, using NCDC criteria.
43 = Begin missing wind data.
44 = End missing wind data.

41-43 SQP SIGNAL QUALITY - Signal quality for the

		element(Pressure) expressed as a percentage of individual samples accepted.
44-46	SQT	(Temperature)
47-49	SQU	(Humidity)
50-52	SQD	(Dew-point temperature)

53-54	EQET	ELEMENT QUALITY FLAGS - These fields contain the results (Elapsed Time) of any quality control procedures for identifying suspect and doubtful individual elements:
55-56	EQP	(Pressure/Ranging) 00 = Element is correct 01 = Element is suspect
57-58	EQH	(Height) 02 = Element is doubtful 03 = Element failed QC checks 04 = Replacement value (correction)
59-60	EQT	(Temperature) 05 = Estimated value 06 = Observer edited value 09 = Element not checked
61-62	EQU	(Humidity)
63-64	EQD	(Dew-point depression)
65-66	EQWD	(Wind direction)
67-68	EQWS	(Wind speed)
69-80	RES FLD	RESERVED FIELD Leave Blank

The data records are repeated as many times as necessary to record all levels of the flight. All fields must be right-justified (least significant digit in the rightmost position) unless specified otherwise. All missing fields must be 9 filled unless specified otherwise. Do not enter decimal points. The decimal point is implied by the field position.

ATTACHMENT C: Guide to Dual Flight Operations: Preparing & Releasing a Dual Flight Bar

Guide to Dual Flight Operations

Preparing & Releasing a Dual Flight Bar

Vaisala RS92-NGP® Sippican B2®

Attachment C

Prepared by
Sterling Field Support Center

Updated April 6, 2012

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

Table of Contents

List of Figures

ACRONYMS AND ABBREVIATIONS

TERMS	DEFINITION
MicroART	Microcomputer Automatic Radio-theodolite
BILS	Balloon Inflation Launch Shelter
CDU	Control Display Unit
DCA	Data Control Assembly
FSD	Frequency Setting Device
GPS	Global Positioning System
hPa.	Hectopascal
IF	Intermediate Frequency
KHz	Kilohertz
LOS	Line-Of-Sight
Mb	Millibar
PSI	Pounds Per Square Inch
IB	Inflation Building
MHz	Megahertz
MSL	Mean Sea Level
NCDC	National Climatic Data Center
NEC	National Electrical Code
NFPA	National Fire Protection Association
NOTAM	Notice to Airman
PITS	Protocol Interface Tests Suite
RF	Radio Frequency
RRS	Radiosonde Replacement System
RSOIS	Radiosonde Surface Observing Instrument System
RTS	Radiosonde Test Stand
RWS	RRS Workstation
SDM	Station Duty Manual
SFSC	Sterling Field Support Center
SPS	Signal Processing System
SPSS	Statistical Package for the Social Sciences
TRS	Telemetry Receiving System
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
UTC	Coordinated Universal Time
WMO	World Meteorological Organization

Introduction

The Upper Air Data Continuity Study (DCS) is useful for investigating the relationship between climate variation and change due to measurement error. To replace the antiquated Microcomputer Automatic Radio-theodolite (MicroART), a system that has been in operation since the late 1980s, new Global Positioning System (GPS) radiosondes have been introduced. The National Weather Service (NWS) upper air network has witnessed a significant impact on operations from the implementation of the new GPS radiosondes due to sensor changes for temperature, pressure and relative humidity measurements. Because these have differing characteristics than other current radiosondes, the DCS is pertinent in assessing the sensors in a variety of climatic and meteorological conditions.

The DCS flight configuration will consist of flying two radiosondes on the same balloon during the 00z and 12z synoptic windows once a week. The day that flights will occur will be left up to the site's discretion; however, once DCS flights begin, the site will continue with that scheduled day. It is suggested that the site conduct operations on a Tuesday, Wednesday or Thursday in order to alleviate issues with holidays or vacations that often occur on a Monday or Friday. These flights must be conducted as precisely as possible in order to accurately assess the sensors' behavior. The purpose of this document is to guide observers through the steps to properly assemble and release a dual flight bar in order to complete an accurate and successful flight using the Vaisala RS92-NGP and Sippican B2 radiosondes.

Procedures

The following procedures detail the prescribed order of operations to be conducted when performing a dual flight. More specific instructions can be found in the Guide to Dual Flight Operations: Performance Checklist for Vaisala RS92-NGP and Sippican B2.

1.) **Equipment Warm-Up**
Powering on Uninterruptible Power Supply (UPS) and other hardware to allow for warm-up operations
2.) **Balloon Inflation and Train Assembly**
Preparing balloon and train assembly for flight
3.) **Radiosonde Preparation**
Preparing radiosondes according to vendor documentation
4.) **Ground Equipment Preparation Procedures**
Completing hardware status checks, pre-release information, instrument baseline and antenna positioning
5.) **Release Site Processes**
Final train preparations, obtaining launch approval, and possible repositioning of antenna
6.) **In-Flight Procedures**
Ensuring release was auto-detected, monitoring the flight using displays and plots, transmitting messages
7.) **Archiving & Post-Flight Test Activities**
Uploading compressed flight data to FTP site for the National Climatic Data Center (NCDC)

Equipment Warm-Up

The observer should begin preparing for a dual flight at least 45 minutes in advance in order to allow adequate time for the workstations and tracking systems to warm-up. Specifically with the TRS, warm-up operations could take 30 minutes, especially in colder temperatures. This also provides the observer with more time to troubleshoot the hardware in the case a problem arises.

- Turn on both the RRS Workstation (RWS) and MicroART computer. Log into the RWS workstation using your individual Username and Password.
- Ensure the GPS repeater is turned on.
- Open the RWS.NET program and click OK in the NOAA Security Warning Window after reading the message.

Figure 24. NOAA Security Warning Window

- Select "Run a Live Flight" and click YES when prompted to turn on the UPS. The UPS provides uninterrupted power to the TRS and SPS. A green checkmark in the Hardware Display will indicate the UPS has been successfully powered on.

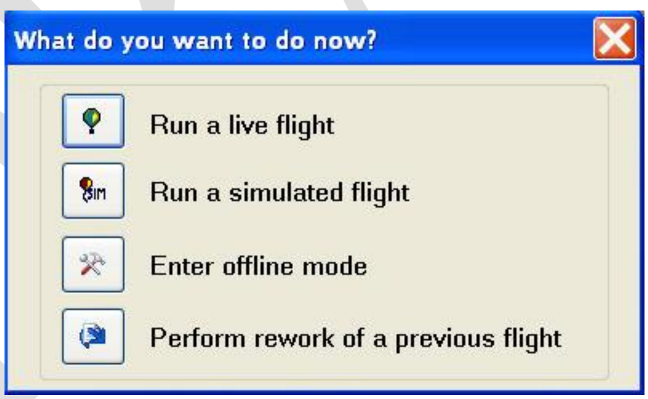


Figure 25. RWS Action Selection Window

- Allow the Telemetry Receiving System (TRS) to perform Motor Warm-Up Operations and/or Initialization. This is dependent upon ambient temperatures. These processes are reflected in the TRS Display, Status Messages and Hardware Status Manager.

***Important: Allow 30 minutes prior to Baseline for the TRS to warm-up. This time is necessary, especially in colder temperatures. The TRS Status Line on the Antenna**

Orientation Display and the Status Messages will indicate “TRS is Ready” when warm-up and initialization is complete.*

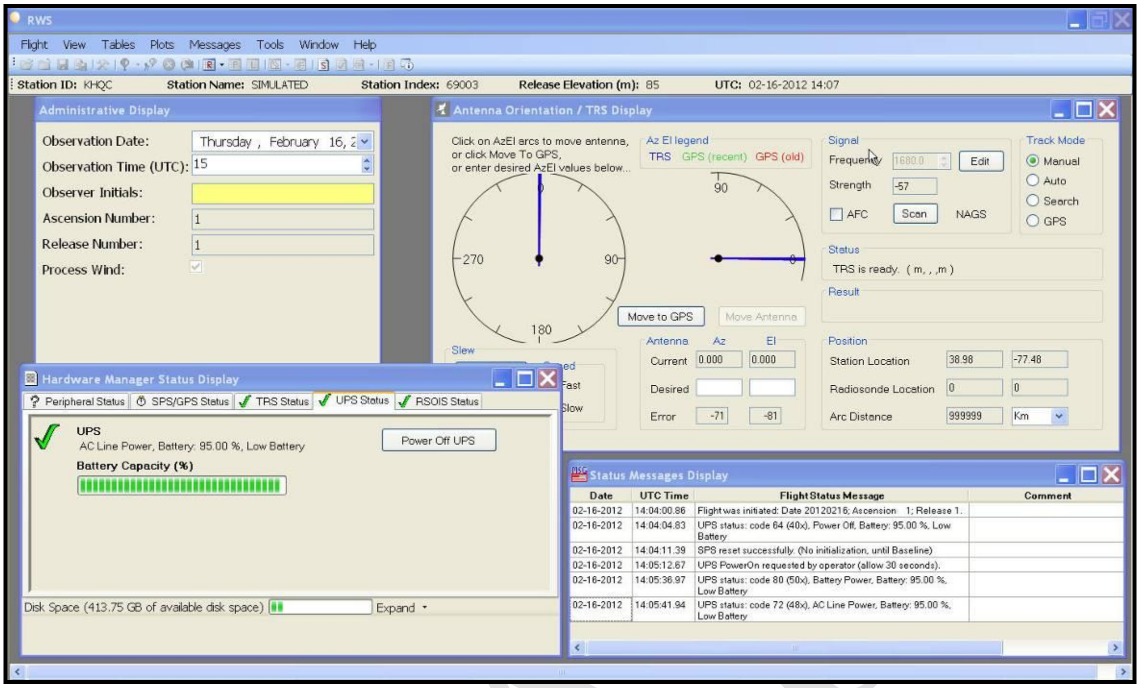


Figure 26. RWS Windows after selecting "Run a Live Flight"

- When prompted, set the date and time for the MicroART. Proceed through the MicroART Virus Scan.
- Turn off Standby and Low Sensitivity on the Data Control Assembly (DCA).

Balloon Inflation and Train Assembly

Pre-observation procedures are an important component of successful upper-air operations. The care taken in preparing for an observation decreases the likelihood of unsuccessful or missed observations due to defective parts or from using improper procedures. The observer should be aware of changing weather conditions that may affect the decision on train components used for the flight, the amount of gas, and release obstacles that may result from such conditions.

The flight bars provided by the Sterling Field Support Center (SFSC) are six feet in length to allow adequate spacing between the radiosondes. This prevents contact with one another mid-flight. Radiosondes are then attached three feet below the bar via the pre-knotted string to reduce solar influences. The entire length of the bar is taped for added strength and additional tape has been applied to the ends of the bar to protect the quality of the Styrofoam from the weight of the instruments.

- Begin inflating an HM-32 1200 gram balloon provided by the Sterling Field Support Center (SFSC)
- Determine the additional weight needed for the dual flight depending on the present weather conditions and those expected at the time of release. The

following chart can assist in determining this weight based on the prevailing weather type and intensity:

Precipitation		**Frozen Precipitation**	
Intensity	**Additional Weight (g)**	**Intensity**	**Additional Weight (g)**
Light Rain	1100-1300 g	Light Frozen	1200-1400 g
Moderate Rain	1300-1500 g	Moderate Frozen	1400-1500 g
Heavy Rain	1500-1800 g	Heavy Frozen	1700-1900 g
No Precipitation: 800-1000 g			

*** This table should only be used as a guideline for applying additional weight since ranges are heavily dependent upon location, temperature variations, and balloon manufacturing procedures. It is important to monitor the flight to ensure SFC-Term ascent rates of 275-350 m/min are being achieved.***

- For actual lift calculations, the following table lists the nominal weights for the train assembly:

Components	**Weight (grams)**
RS92-NGP Radiosonde	305
B2 Radiosonde	475
Spreader Bar Assemble	214
Parachutes (2)	150
Total	1144

- To prepare the train using two parachutes, first tie a seven foot length of double strand cord to the loop on the top parachute, leaving free the other end of the string. This will be used to tie the balloon neck. Repeat this step again, except tying the cord to the loop of the bottom parachute. This cord should then be knotted securely to the string extending down from the top parachute.

Figure 27. Observer tying top and bottom parachutes together

Figure 28. Knot joining top and bottom parachutes

- To avoid temperature contamination from the balloon wake, the recommended train length for test flights is 30-37 meters. However, this may not be practical under certain wind and weather conditions. Based on these conditions at release, adjust the remainder of the train so the total length meets standards as indicated below, securing the flight train to the bottom of the second parachute:

Wind Speed (knots)	Train Length (meters)	Train Length (feet)
0-5	37	120
6-10	27	90
10-15	23	75
>15	Consider canceling DCS Flight	

Note: The total train length (70-120 feet) is the distance extending from the balloon neck to the top of the flight bar. It does not describe the length from the bottom of the second parachute to the top of the flight bar.

***The minimum train length should not be less than that which the NWS considers acceptable for operations (21 meters). Trains less than the prescribed length should never be used since this increases the risk of the radiosonde being too close to the radiation environment of the balloon or from encountering the balloon's wake as it ascends. Erroneous data may result from these occurrences. ***

- SFSC will provide flight bars with the flight bar assembly attached. Position and secure the flight bar on the Radiosonde Test Stand (RTS) and tie the train assembly to the end of the string extending from the top of the bar.

Figure 29. Tying flight train to flight bar

Figure 30. Knot connecting flight train and flight bar

- **When Applicable:** Because the flight train is longer and larger in mass, two glow sticks should be used for a nighttime dual release. Attach one glow stick to the end of the second parachute with the small strings that extend from the knot. The second glow stick should be tied to the bottom of the flight train where it is connected to the flight bar.

- Once the balloon has finished filling, complete the flight train by tying the top parachute to the balloon neck, allowing a minimum of six feet between them. Ensure the flight train is complete elsewhere and inspect tie points to verify all knots are tight.

Figure 31. Completed flight train

***Warning: Because some inflation bays are lower than others and additional weights increase its size, be mindful when filling the balloon and preparing it for release so that it does not touch the ceiling. This can puncture the balloon, creating a leak, or pop the balloon completely. ***

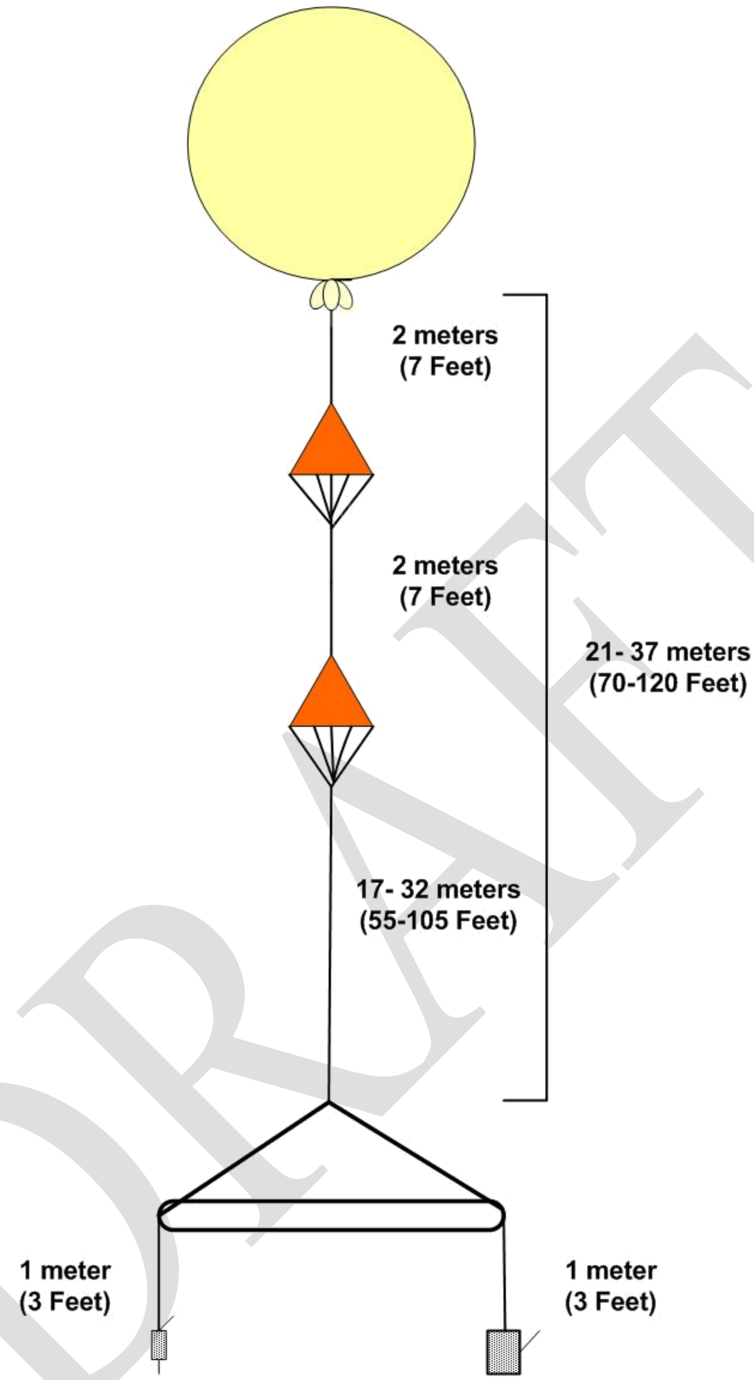


Figure 32. Schematic of completed flight train

Radiosonde Preparation

Using the provided radiosonde and battery preparation instructions and NWS standard procedures, prepare the radiosondes for flight. It is pertinent that the instruments be handled carefully so that contamination to the sensors by the observer can be alleviated. Mishandling the unit could also comprise the integrity of the data during flight.

Setting the radiosonde frequencies is one of the most critical parts of the preflight operation procedures. Because the frequency on the Sippican B2 radiosonde could drift upwards during the flight, SFSC recommends this radiosonde to be set to 1680 megahertz (MHz). To compensate, it is recommended to adjust the frequency of the Vaisala RS92-NGP radiosonde to 1676 megahertz (MHz). This should avoid the B2 radiosonde signal from interfering with that from the RS92 since the RS92 should not drift by more than 0.1 MHz. A Frequency Setting Device (FSD) will be supplied with the Vaisala radiosondes and is used not only to set the frequency, but to burn contaminants off of the sensors before the flight. To use this device, a cable is plugged into the bottom of the radiosonde and the frequency is selected from simple button options. These button options are channels with corresponding frequencies, including 1676, 1678, 1680, and 1682 MHz. The digital screen will read that the “Radiosonde is Ready” upon completion.

Figure 33. Vaisala RS92-NGP on Frequency Setting Device (FSD)

While inside, especially during the baseline process, it is important to keep the radiosondes at least six feet apart. This will help to eliminate interference between frequencies. Although the radiosonde batteries should not be plugged in until ground equipment preparation procedures have been completed, it is necessary to plug in and lock on to the B2 radiosonde prior to powering on the RS92-NGP. This will help to prevent the ART from locking onto the RS92-NGP signal. It is also suggested that the station record the actual frequency used for both instruments in case an operational second release is required. If a second release is required, the observer should select a frequency not previously used to avoid cross-contamination of signals.

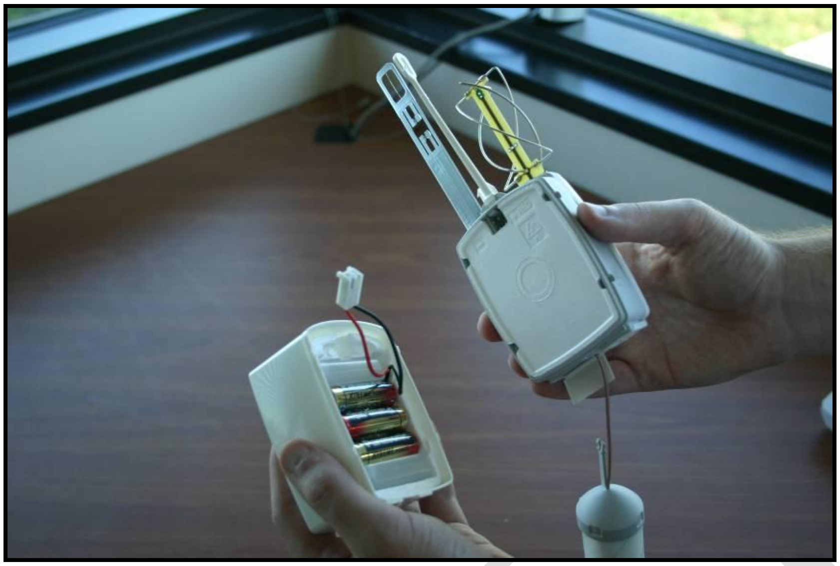


Figure 34. Plugging in the RS92-NGP battery

Figure 35. Preparing the Sippican B2 battery

Ground Equipment Preparation Procedures

Once the flight train and radiosondes have been prepared, the ground equipment procedures must be completed prior to releasing the balloon:

- Position the TRS antenna within a few degrees of the baseline point using the Antenna Display Window. Complete the Administrative and Equipment Displays then click Next;
- Position the ART antenna within a few degrees of the documented target antenna. Turn the target antenna switch on and allow the antenna to lock on the target antenna by pressing Far Auto;
- From the ART Options Menu, select ART Observation. When prompted, complete the Administrative Data and Flight Equipment Data screens;

- In RWS, set the radiosonde frequency in the TRS Display after placing the TRS in Manual Track Mode. This can be done by clicking Edit, entering the frequency, clicking Set and turning AFC ON;
- Complete the VIZ Radiosonde Data screen and insert the appropriate Calibration Diskette into the drive hen prompted; and
- At this time, complete the radiosonde procedures by preparing and activating batteries.

Ensure that the Sippican B2 and Vaisala RS92-NGP radiosondes are no closer than six feet from one another during the baseline process. It is important to plug in and lock on to the B2 radiosonde before plugging in the RS92-NGP. If this is not completed, it is likely the ART will lock onto the RS92-NGP.

- Complete the Surface Observation Display and Surface Data screen in both RWS and MicroART using the most recent surface observation. This should be completed no more than 10 minutes prior to release. Confirm that batteries are plugged in before beginning baseline.
- Continue to the cross-check message screen in MicroART to review any inconsistencies. Insert the Log Diskette and press enter when ready. Adjust the Azimuth to the appropriate angle to prepare for baseline and acquire a radiosonde signal. Check the AFC meter to ensure the transmitter signal is being received clearly. Press Standby once this is complete.
- In RWS, click Next from the Surface Observation Display to begin the baseline process. In MicroART, press Enter to begin the baseline check. Once the readings become stable, compare the instrument's readings against the surface conditions entered.

Once the Baseline Display window has appeared and started populating, wait at least five minutes before accepting. Time is needed for the sensors to stabilize and for a proper pressure correction to be calculated. Baseline MUST be accepted before releasing the balloon.

Note: Ensure pressure sensor has stabilized prior to accepting baseline. The battery and pressure sensor must warm-up. If the pressure sensor is not warmed up, pressure discrepancy may create height errors.

- If the pressure discrepancy is within ± 3 hPa for the Vaisala RS92-NGP radiosonde and the temperature and relative humidity values look reasonable, click Accept. Do not complete baseline without GPS. "Waiting for Release" will then be displayed on the RWS screen.
- For the MicroART, press F10 to complete baseline. After the baselining tests are complete, accept the radiosonde by clicking enter if the pressure discrepancy is within ± 5 hPa. The Antenna Lock screen will display ***RADIOSONDE READY FOR RELEASE***.
- Before proceeding to the release site, put the TRS in Manual Track Mode and direct the Azimuth/Elevation to where the radiosonde is expected to travel. For the ART, ensure that Standby is illuminated and move the Azimuth/Elevation to where the

radiosonde is expected to travel. Confirm that the Track Mode for the ART is set to Manual.

- The TRS is 180 degrees out from the wind direction. Because they can easily be confused with the ART, the following chart lists pressure discrepancy thresholds and orientation of the antenna before and during the flight:

	Pressure Discrepancy	**Antenna-North**
TRS	Vaisala RS92-NGP: ± 3 hPa	Azimuth of 0 degrees
MicroART	Sippican B2: ± 5 hPa	Azimuth of 180 degrees

Release Site Processes

- Upon arriving at the release location, tie the radiosondes to the assembled flight bar, first attaching the Vaisala RS92-NGP radiosonde to the string that has a knotted loop. The loop should be slipped through the gaps in the eyelet. Following this, the B2 radiosonde should be tied on to ensure that it hangs at the same height as the RS92-NGP. This enables the radiosondes to measure the same atmospheric column, yielding a more precise data comparison.

Figure 36. RS92-NGP hanging from knotted loop on assembled flight bar

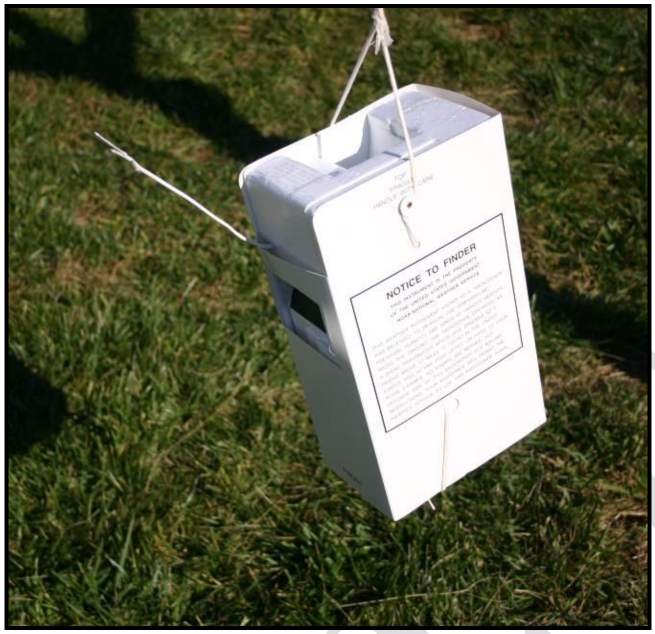


Figure 37. Sippican B2 tied to assembled flight bar

Figure 38. Completed flight bar with RS92-NGP and Sippican B2 radiosondes

- Visually inspect the release zone and the anticipated path of flight for any obstacles or dangers. Check the flight train's integrity and ensure radiosondes are secure on the flight bar.
- If within five nautical miles of an airport, call the airport control tower and request approval to release the balloon.

- When positioning for release, the individual holding the spreader bar assembly should be downwind from the individual handling the balloon. Keep the bar and radiosondes as level as possible during the release.
- As the observer with the balloon moves from the inflation bay, he/she should be maneuvered upwind in order for the balloon to pass overhead of the individual holding the bar.
- If possible, the distance between the observers should be such that the string has no slack and the balloon and released. This will help to prevent the flight train from becoming tangled. The observer with the balloon should be facing the observer holding the bar. This will allow for better control of the flight bar when the balloon is released depending on dominant wind conditions.
- While one observer releases the balloon, another observer should keep a loose grip on the flight bar, cradling it above and away from their body. As they move in the direction of the balloon, the bar will be lifted by the balloon out of the observer's hands.

Figure 39. Preparing for balloon release with flight bar

Figure 40. Balloon passing overhead of observer with flight bar

Figure 41. Release of flight bar

- Once the balloon is released, the observer should then hit the release pulse as the other observer lets go of the bar. The ART timed release may be used, but a best effort should be made to time when the spreader bar will begin its ascent.
- After release, the observer can use the TRS remote Control Display Unit (CDU) to verify the frequency has not shifted for the Vaisala RS92-NGP. Double check to ensure the antenna is positioned to the appropriate azimuth and elevation and that AFC is on. After returning to the workstation, check to make sure release was detected. RWS should automatically detect release. Update the Surface Observation and release time as necessary.
- Upon returning to the RWS workstation, verify the TRS signal strength is acceptable. If GPS is being received, place the Antenna into Search mode in the Antenna Orientation Display. Auto track mode will automatically be selected once the TRS has detected the strongest signal. The TRS can also be pointed towards the balloon in the Azimuth/Elevation window by inputting values and clicking Move Antenna or

Move to GPS. **Do not click Move to GPS if GPS data is unavailable as this may cause the software to freeze.**

- To verify that release has been detected and logged correctly, check the first pressure data point below the red line in the Received PTU Tabular Display. This point should have a pressure equal or less than the release pressure shown in the Surface Observation at release. Check the Geopotential Height and ensure it increases with time.
- For the Sippican B2, open the ART remote release panel and turn up the speaker volume to check for a clean signal. Initiate release, then adjust the position to acquire and maintain a lock to the radiosonde. Turn Auto Track and AFC On. After returning to the PC, enter the time the antenna locked onto the radiosonde and delete position data up to the point lock-on occurred. Verify the Surface Observation screen as necessary.
- Monitor the B2 signal strength and adjust the Azimuth and Elevation if necessary to maintain a lock onto the radiosonde. The audio should be utilized to verify accurate instrument tones and to check for interference or signal loss.

In-Flight Procedures

During the flight, to the extent possible, site personnel will monitor the flight for potential problems and ensure the validity of the test. Any problems should be documented and the site should notify the RRS Help Line. Since the RWS system acts as the operational system, it is imperative the flight be quality controlled in an operationally acceptable manner. With regard to the MicroART flight, the operator may quality control the data if time permits. However, it is not necessary since office operations will always take precedence.

Monitoring the flights using displays and plots can assist in ensuring the flight is successful. A variety of parameters can be plotted, including temperature, winds and relative humidity. This data should be quality controlled throughout the flight in order for the observer to determine if edits are necessary, especially in RWS. Periodically checking the Check and Status Messages and incoming meteorological data also assists the observer in verifying ascent rates are realistic. These averages should be approximately 5 meter/sec or 275-350 meter/min. Furthermore, confirm RADAT and Coded Messages appear to be correct, especially before message transmission is initiated.

Upon completion of the flight, both RWS and MicroART will detect termination. Transmit all remaining messages before closing each program. In RWS, the flight must be closed before the observer can exit RWS. The UPS should be turned off when prompted. Although the flight has been closed, it can still be opened in Rework if additional edits are desired. For MicroART, exit the ART Observation option by typing EXIT at the ?> prompt. Remove the Log diskette from the diskette drive and insert the Store diskette currently in use.

Archiving & Post-Flight Test Activities

After each test flight, the data from both systems will be archived in a manner consistent with established site procedures. Personnel will make every effort to complete the Data Continuity Input Form immediately after the flight. If this is not possible, it should be completed by the end of the current shift. Additionally, when the B29 form is completed, the remark “DCS flight” should be noted in the Remarks section. Other remarks may be entered at the discretion of upper air personnel. The site should contact SFSC if a significant event occurred which may have a negative impact on the DCS flight.

NWS Sterling Field Support Center

The NWS Sterling Field Support Center serves to provide operational assistance to National Weather Service field personnel with questions that pertain with the operation of a new RWS system, including pre-flight and flight assistance during synoptic soundings. The SFSC assists users in order to ensure continuity in understanding of the RWS system and quality data collection among all operating deployment sites.

Hours of Operation	**Contact**
M-F 10:00-02:00 UTC	(301) 713-9800 (703) 661-1293

ATTACHMENT D: Guide to Dual Flight Operations: Performance Checklist for Vaisala RS92-NGP and Sippican B2

Guide to Dual Flight Operations

Performance Checklist

Vaisala RS92-NGP® Sippican B2®

Attachment D

Prepared by
Sterling Field Support Center

Updated April 6, 2012

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

TIME TO LAUNCH	**PRE-RELEASE CHECKLIST FOR DUAL FLIGHTS RRS & MICROART**
T- 60 minutes	• Turn on both the RWS and MicroART systems. Log onto the RWS workstation using your individual Username and Password. • Make sure both computers are time synced. • Turn on the GPS repeater. ***RWS*** • Open the RWS.NET program and click OK in the NOAA Security Warning Window after reading the message. • Select Run a Live Flight. • Click YES when prompted to power on the UPS. The UPS provides uninterrupted power to the TRS & SPS. A green checkmark in the Hardware Display will indicate the UPS has been successfully powered on. • The TRS will then perform Motor Warm-up Operations and/or Initialization, depending on the ambient temperature. These processes are reflected in the TRS Display, Status Messages and Hardware Status Manager. ***Important: Allow 30 minutes prior to Baseline for the TRS to warm-up. This time is necessary, especially in colder temperatures. The TRS Status Line on the Antenna Orientation Display and the Status Messages will indicate "TRS is Ready" when warm-up and initialization is complete.*** ***MicroART*** • When prompted, set the date and time. • Proceed through the MicroART Virus Scan. • Turn ART off of Standby and Low Sensitivity.
T- 35 minutes	• Begin filling the upper-air balloon and prepare the flight train (reference Guide to Dual Flight Operations: Preparing and Releasing a Dual Flight Bar) ***Warning: Because some inflation bays are lower than others and additional weights increase its size, be mindful when filling the balloon and preparing it for release so that it does not touch the ceiling. This can puncture the balloon, creating a leak, or pop the balloon completely. ***
T-25 minutes	• Inspect and prepare radiosondes in accordance with supplied specifications. Suggested frequency for RS92-NGP is 1676 MHz and for Sippican B2 is 1680 MHz. Do not prepare or connect the batteries as this will be completed closer to baseline.

TIME TO LAUNCH	PRE-RELEASE CHECKLIST FOR DUAL FLIGHTS RRS & MICROART
T-15 minutes	***RWS*** • Complete Administrative Display and click Next. • Complete Equipment Display and click Next. ***MicroART*** • Position the antenna manually within a few degrees of the documented target antenna. Turn the target antenna switch on and allow the antenna to lock on the target antenna by pressing Far Auto. • From the ART Options Menu select ART Observation. The Administrative Data screen appears. Complete the Administrative Data screen. • Complete the Flight Equipment Data screen.
T-13 minutes	***RWS*** • Set the Radiosonde Frequency in the TRS Display after placing the TRS in Manual Track Mode. This can be done by clicking Edit, entering the frequency, clicking Set and turning AFC ON. • Point the TRS toward baseline Azimuth/Elevation in the TRS Display by entering the values in the desired cells and clicking Move Antenna. ***MicroART*** • Complete the VIZ Radiosonde Data screen. • Insert Calibration Diskette into drive when prompted.

<table>
<tr><th>TIME TO LAUNCH</th><th>PRE-RELEASE CHECKLIST FOR DUAL FLIGHTS
RRS & MICROART</th></tr>
<tr><td>T-10 minutes</td><td>

Complete radiosonde procedures, specifically battery preparation and activation. Place the radiosondes in the appropriate location for baseline. Ensure that the Sippican B2 and Vaisala RS92-NGP radiosondes are no closer than 6 feet from one another during the baseline process.

* Plug in and lock on to B2 radiosonde before plugging in RS92-NGP*
RWS

Complete the Surface Observation Display. Click Next to begin the baseline process.

Ensure battery is plugged in before beginning baseline

The Waiting for SPS to Initialize window will appear. Once the SPS initializes, the Baseline Display window will begin populating first with PTU data, followed by Lat/Lon data.

(If the SPS doesn’t initialize by the end of the progress bar, click Wait Again.)
*** Wait at least 5 minutes before proceeding to next step ***
NOTE: Ensure pressure sensor has stabilized prior to accepting baseline. The battery and pressure sensor must warm-up. If the pressure sensor is not warmed up, pressure discrepancy may create height errors.

If the pressure discrepancy is within $\pm$ 3 hPa and the temperature and relative humidity values look reasonable click Accept.
Do not complete baseline without GPS data.
“Waiting for Release” will be displayed on the RWS screen.

MicroART

Fill out the Surface Data Screen using the most recent surface observation.
Continue to the cross-check message screen to review any inconsistencies. Insert Log Diskette and press enter when ready.
Adjust the Azimuth to the appropriate angle to prepare for baseline and acquire a radiosonde signal. Check the AFC meter to ensure the transmitter signal is being received clearly. Press standby once this is complete.
Press Enter to begin the baseline check. Once the readings become stable, compare the instrument’s readings against the surface conditions entered.

*** Wait at least 5 minutes before proceeding to next step ***

Press F10 to complete baseline.
After the baselining tests are complete, accept the radiosonde by clicking enter if the pressure discrepancy is within $\pm$ 5hPa.
The Antenna Lock screen will display ***RADIOSONDE READY FOR RELEASE***.

</td></tr>
</table>

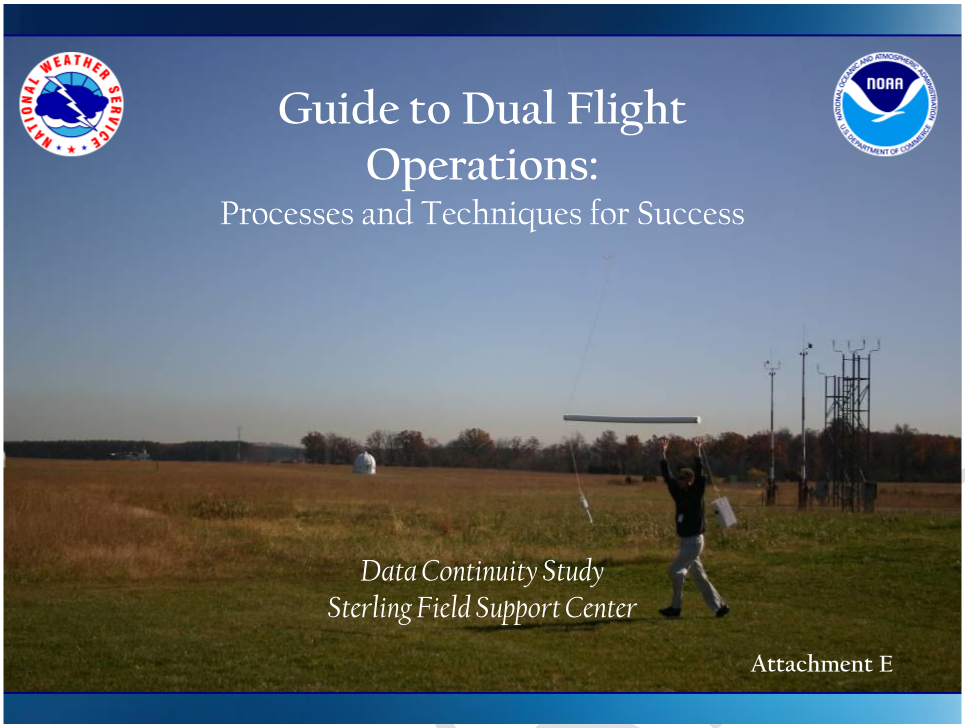
TIME TO LAUNCH	PRE-RELEASE CHECKLIST FOR DUAL FLIGHTS RRS & MICROART
T-03 minutes	***RWS*** • Put the TRS in Manual Track Mode and direct the Azimuth/Elevation to where the radiosonde is expected to travel. **NOTE:** To point the TRS north, input an AZ of 0 degrees. The TRS is 180 degrees out from the wind direction. ***MicroART*** • Ensure that Standby is on before proceeding to the release site. Move Azimuth/Elevation to where the radiosonde is expected to travel. • Ensure that Track Mode is set to Manual. **NOTE:** To point the MicroART north, input an AZ of 180 degrees. • Proceed to the release location.
T-02 minutes	***RWS*** • Check the RCDU to ensure frequency has not shifted off the radiosonde and the signal is strong. (Listen to the audio output- noise heard is the radiosonde) • Double check to ensure the TRS Antenna is positioned to the appropriate azimuth and elevation. ***MicroART*** • Open the remote release panel to turn on the power, and turn up speaker volume to check for a clean signal.
T-01 minutes	• Tie the radiosondes to the assembled flight bar and ensure they are hanging at the same height relative to one another. • Check the flight train's integrity and visually survey the release zone and the anticipated path of flight. • Minimize potential for obstacles. • **If Applicable:** Call the local airport control tower and request flight clearance for balloon release if the airport is within 5 miles.

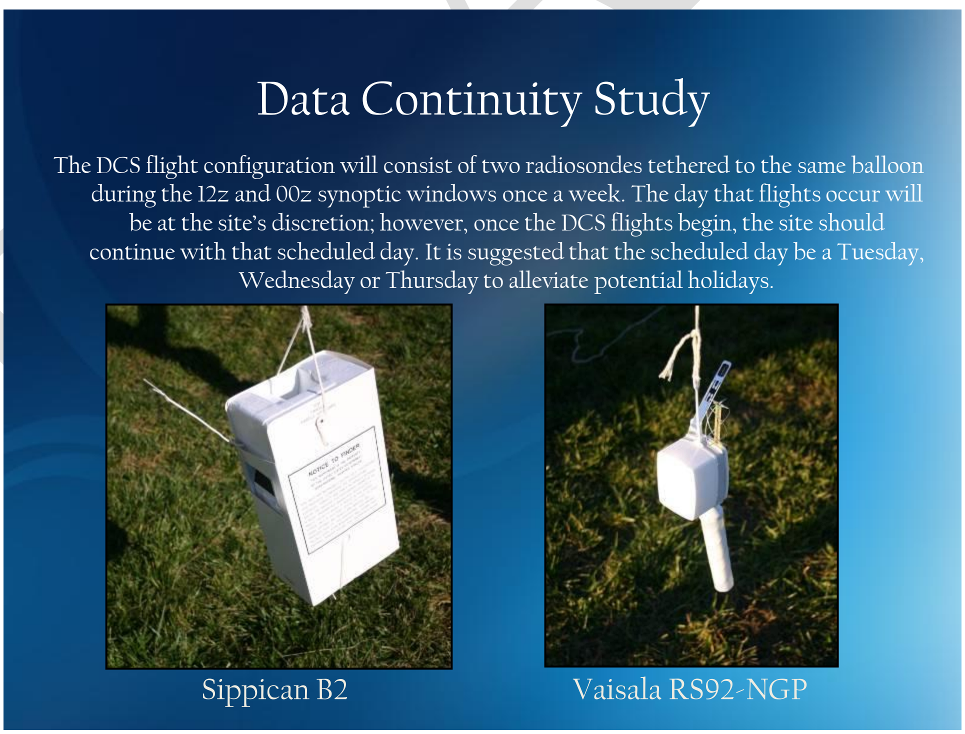
TIME TO LAUNCH	PRE-RELEASE CHECKLIST FOR DUAL FLIGHTS RRS & MICROART
T-00 minutes	• Observer should release the radiosondes and use the RCDU to verify the frequency has not shifted off the radiosonde and the signal is strong. (Listen to audio) • Double check to ensure the Antenna is positioned to the appropriate azimuth and elevation and that AFC is on using the RCDU.

IN ORDER	IN-FLIGHT CHECKLIST FOR DUAL FLIGHTS RRS & MICROART
STEP 1	***RWS*** • Ensure the release has been detected (Release time is displayed in the flashing blue screen and in the Status Messages), and click **“Continue”**. Update Post-Release Surface Observation as necessary. ***MicroART*** • On the Antenna Lock screen, enter the time the antenna locked on to the radiosonde and press Enter. • Check the MCU readings and MicroART computer displays and verify the signal is strong. If the signal is strong and the antenna is locked on the main signal, delete position data up to the point that lock-on occurred. • Verify the Surface Observation screen as necessary.
STEP 2	***RWS*** • Verify that the TRS signal strength is acceptable. If GPS is being received, place the Antenna into the **Search** mode using the Antenna Orientation/TRS Display Point the TRS toward the balloon by inputting Azimuth/Elevation values and clicking **Move Antenna** or **Move to GPS**. (**Do not click Move to GPS if GPS data is unavailable**) • The **Search** Track Mode can be used to search for the radiosonde. **Auto Track** mode will automatically be selected once the TRS has detected the strongest signal. • Open up the Processed Tabular Display and scroll to the bottom of the display. (Right-click on the scroll bar and select **Bottom**) ***MicroART*** • Monitor the signal strength and adjust the Azimuth/Elevation if necessary to maintain a lock onto the radiosonde. The audio should be utilized to verify accurate instrument tones and to check for interference or signal loss.

IN ORDER	IN-FLIGHT CHECKLIST FOR DUAL FLIGHTS RRS & MICROART
STEP 3	***RWS*** • Verify that Release has been detected correctly. Ensure the first pressure data point below the red line in the Received PTU Tabular Display has a pressure equal to or less than the Release Pressure shown in the Surface Observation at Release. Check the Geopotential Height and ensure it increases with time. Otherwise change the release time as appropriate.
STEP 4	***RWS*** • Monitor flight using Displays and Plots. (Basic Screens: SPS/GPS Window, Antenna/TRS Display, Temp or Temp/RH Plot, Trajectory Plot, Processed Tabular Data Display or Processed Data Bar) ***MicroART*** • Monitor flight using Displays and Plots.
STEP 5	• Always look at Check and Status Messages, Temp or Temp/RH Plot and verify the Ascent Rates are realistic (averages approximately 5 m/sec). • Verify RADAT or Coded Messages appear to be correct.
STEP 6	• Review selected plots and data at least every 15 minutes during the flight. Always perform Step #5 prior to message transmission. • Prior to Message Transmission at termination, ensure all Check and Status Messages look reasonable. Do the same for the data plots.
STEP 7	***RWS*** • **Turn UPS OFF** at termination through RWS when prompted. ***MicroART*** • Upon transmitting the coded messages, exit the Art Observation option.
STEP 8	• Close the flight. **DO NOT CLOSE RWS.** • Upon termination of the flight, complete the online data form with required information and any comments pertinent to the flight. Click **Submit**.

ATTACHMENT E: Guide to Dual Flight Operations: Techniques and Processes for Success





Weights for Flight Bar Assembly

- Balloon
  - 1200 grams
- Vaisala RS92-NGP
  - 305 grams
- Sippican B2
  - 475 grams
- Flight Bar
  - 214 grams
- Parachute
  - 75 grams
- Glow Stick
  - 24 grams

Total Weight of Dual Flight Assembly: ~2392 grams

Setting Radiosonde Frequency

- Because the frequency on the Sippican B2 radiosonde could drift upwards during the flight, set its frequency at 1680 MHz.
- The recommended frequency for the Vaisala RS92-NGP is 1676 MHz. This is Channel 1 (CH1) on the Vaisala Frequency Setting Device.

Radiosonde Preparation

- Prepare the radiosondes according to supplied documentation.
- While indoors, specifically during the baseline process, keep the radiosondes at least 6 feet apart. This will help to eliminate interference between the frequencies.
- Plug in and lock on to the B2 radiosonde prior to powering on the RS92-NGP.

Ground Equipment Preparation

- Important to Remember
  - Allow at least <u>30 minutes</u> prior to baseline for the TRS to warm-up. Antenna Orientation Display & Status Messages will indicate "TRS is Ready."
  - Once the Baseline Display window has appeared and started populating, wait at least <u>5 minutes</u> before accepting. Time is needed for the sensors to stabilize and for a proper pressure correction to be calculated.
  - Baseline *MUST* be accepted before releasing the balloon. Failure to do so will result in a required termination of the flight.

The following chart lists pressure discrepancy thresholds and orientation of the antenna for the flight:

	Pressure Discrepancy	Antenna - North
TRS	Vaisala RS92-NGP: ± 3 hPa	Azimuth of 0 degrees
MicroART	Sippican B2: ± 5 hPa	Azimuth of 180 degrees

Determining Additional Weight for Balloons

Liquid Precipitation		Freezing/Frozen Precipitation	
Type	Additional Weight (g)	Type	**Additional Weight (g)**
Light	+ 1100-1300 g	Light	+ 1200-1400 g
Moderate	+ 1300-1500 g	Moderate	+ 1400-1500 g
Heavy	+ 1500-1800 g	Heavy	+ 1700-1900 g
No Precipitation: 800-1000 g			

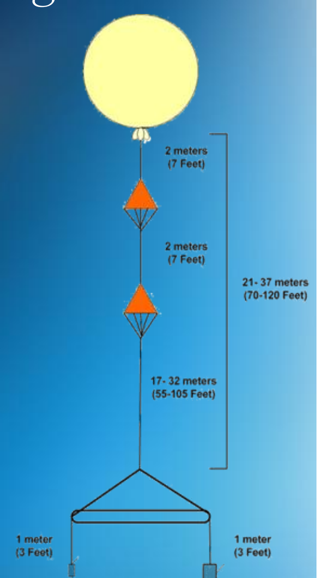
Note: This table is only meant to provide suggested values. Each site might experience different results.

- It is important to determine the appropriate amount of weight to keep ascent rates in target range. The addition of weights should be based primarily upon the present weather conditions.
- If winds are strong, tend towards the higher side.
- Ascension rates should be between 275-350 m/min.
- Be mindful of inflation bay height and other surrounding obstacles when adding weights and filling the balloon!

Determining Train Length

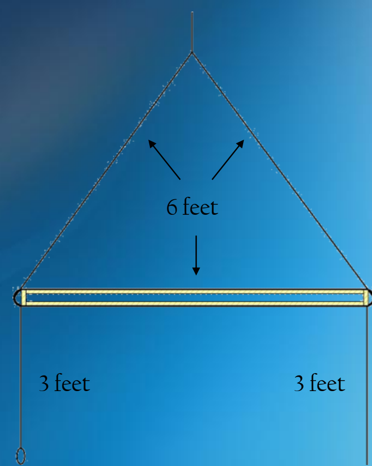
Wind Speed (knots)	Train Length (meters)	Train Length (feet)
0-5	37	120
5-10	27	90
>10	21	70

- Prepare the train using two parachutes when performing a dual flight. The increased weight from an additional radiosonde and a flight bar makes this second parachute necessary to sustain the weight while descending.
- There should be approximately 7 feet between the top parachute and balloon neck, and between the top and bottom parachutes.
- Total train length should be between 70-120 feet. Trains shorter than this length increase the risk of the radiosonde being too close to the heat radiating from the balloon or from the balloon's wake as it ascends.
- No dual flights should be released when winds are greater than 20 knots.



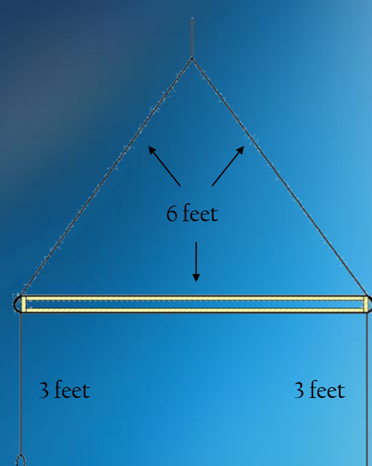
Preparing a Dual Flight Bar

- The flight bar is 6 feet long to allow adequate spacing between the radiosondes.
- Radiosondes are attached 3 feet below the bar to reduce solar influences.
- The entire length of the bar is taped for added strength.
- Additional tape is applied to the ends of the bar to protect the Styrofoam.



Preparing a Dual Flight Bar

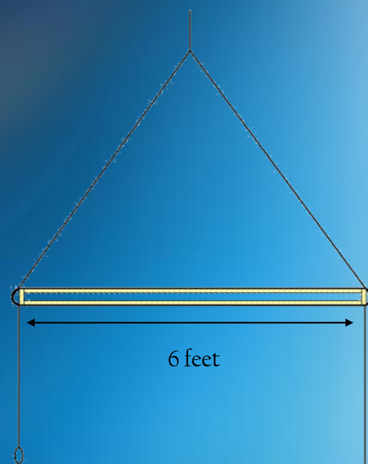
- When preparing the flight train, ensure the radiosondes are hanging at the same height.
- This enables the radiosondes to measure the same atmospheric column, yielding a more precise data comparison.



<u>If Applicable:</u> Call the airport control tower to request flight clearance!

Launching a Dual Flight Bar

- More concern should be taken when launching a dual flight bar. The flight assembly is more likely to become tangled or obstructed during the release process.
- Position the balloon upwind from the radiosondes in order for it to pass overhead. The observers should be facing one another.
- Keep a loose grip on the flight bar, cradling it above and away from the body. Holding the bar tightly will cause the radiosondes and bar to spring/break upon release.
- The observer with the bar should move in the direction of the balloon during release.



Monitoring & Tracking a Dual Flight

RWS

- Utilize the RCDU to ensure frequency has not shifted off the radiosonde and that signal is strong.
- Check the TRS Antenna position and direct it to the appropriate azimuth and elevation.
- Turn AutoTrack and AFC ON.
- When returning to the workstation, check to make sure release was detected (RWS should automatically detect release). Update Surface Observation as necessary.
- Verify release time and update if needed.

MicroART

- Turn on the remote release panel and check for a clean signal.
- Initiate release, then adjust the position to acquire and maintain a lock to the radiosonde.
- Turn AutoTrack and AFC ON.
- At the PC, enter the time the antenna locked onto the radiosonde.
- Verify signal is strong and delete position data up to the point lock-on occurred. Verify the Surface Observation screen as necessary.

Monitoring & Tracking a Dual Flight

- Monitor the flights using displays and plots.
- Always look at Check and Status Messages, incoming meteorological data and verify the ascent rates are realistic (averages approximately **5 m/sec** or **275-350 m/min**).
- Verify RADAT and Coded Messages appear to be correct, especially before message transmission.

Upon Termination:

RWS

- RWS will automatically detect termination.
- Transmit all remaining messages.
- Close the flight, turning OFF the UPS when prompted.
- Make any necessary edits and archive the flight.

MicroART

- MicroART will automatically detect termination.
- Transmit all remaining messages.
- Exit the ART Observation option by typing EXIT at the ?> prompt.
- Remove the Log diskette from the diskette drive and insert the Store diskette currently in use.

General Test Policies

- The Vaisala RS92-NGP radiosonde will serve as the operational sounding when the dual flights take place. It is necessary that erroneous data in RWS be marked according to operational practices in order to maintain quality control.

- MicroART products will not be transmitted but will be archived using existing procedures. Edits to the MicroART data are not required but are desirable if not impacting operations.

- Both the RWS and MicroART flights should be archived according to current methods in use at each individual site.

Additional Test Policies

- No second releases will be performed for a dual flight
  - If the B2 radiosonde fails and the RS92-NGP does not, continue to fly until termination occurs.
  - If the RS92-NGP fails to make 400 hPa, follow station policy for a second release **without** the B2.
  - Missed or unsuccessful DCS flights will be appended to the end of the test period.
  - Continue the 7-day interval until 120 good paired flights are acquired.

- Criteria that qualifies a successful flight:
  - Minimum pressure requirement of 30 hPa
  - Target pressure of 10 hPa

Additional Test Policies

- If it becomes apparent that two or more consecutive test flights will be missed, the SFSC should be notified. All missed flights will be recorded on the DCS web site. Plausible reasons for missing a test flight are as follows:
  - Office operations would be adversely impacted if site performs DCS flight as scheduled.
  - Conditions exist which may result in injury to personnel or property if the DCS flight is attempted.
  - One or both ground stations are working improperly.
  - Weather conditions are such that a successful release would not be likely.
  - At the request of the SFSC or NWSHQ.

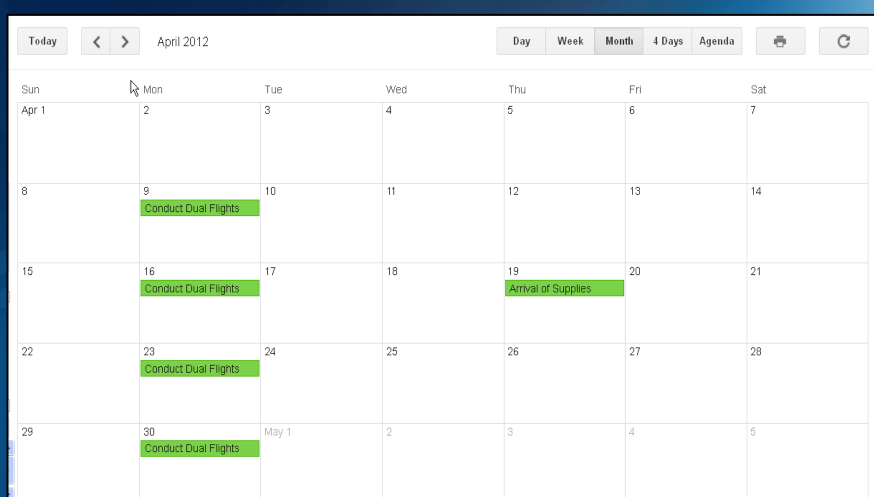
Delivery Schedule For SFSC Supplied Resources

- Initial supplies will be shipped to each site 60-90 days prior to the start of DCS
- Additional resources will be sent every 90-120 days
  1. Radiosonde Test Stand (one time)
  2. Flight spreader bars
  3. Balloons
  4. Extra Parachutes

Monitoring of Activities

- A schedule for each site will be created in order to keep track of scheduled flight days, arrival of supplies, and other reminders for both the site and SFSC.
- Monthly progress reports will be issued and available via the Web.

Google Calendar Example



Field Support Resources

- SFSC Guides to Dual Flight Operations
  - "Preparing & Releasing a Dual Flight Bar" Procedures
  - RS92-NGP and Dual Flight Performance Checklist
  - "Techniques & Processes for Success" Training Presentation
  - "Vaisala RS92-NGP Preparation and Performance" Training Presentation
- DCS Training Video
  - "How to Perform a Successful Dual Flight"
- DCS Website
  - http://www.nws.noaa.gov/ops2/ops22/sfsc%20html/DCS_new.htm
- SFSC Helpdesk Operations

NWS Sterling Field Support Center

The NWS Sterling Field Support Center serves to provide operational assistance to National Weather Service field personnel with questions that pertain to the operation of a new RWS system, including pre-flight and flight assistance during synoptic soundings. The SFSC assists users in order to ensure continuity in understanding of the RWS system and quality data collection among all operating deployment sites.

Hours of Operation

M-F

10:00-02:00 UTC

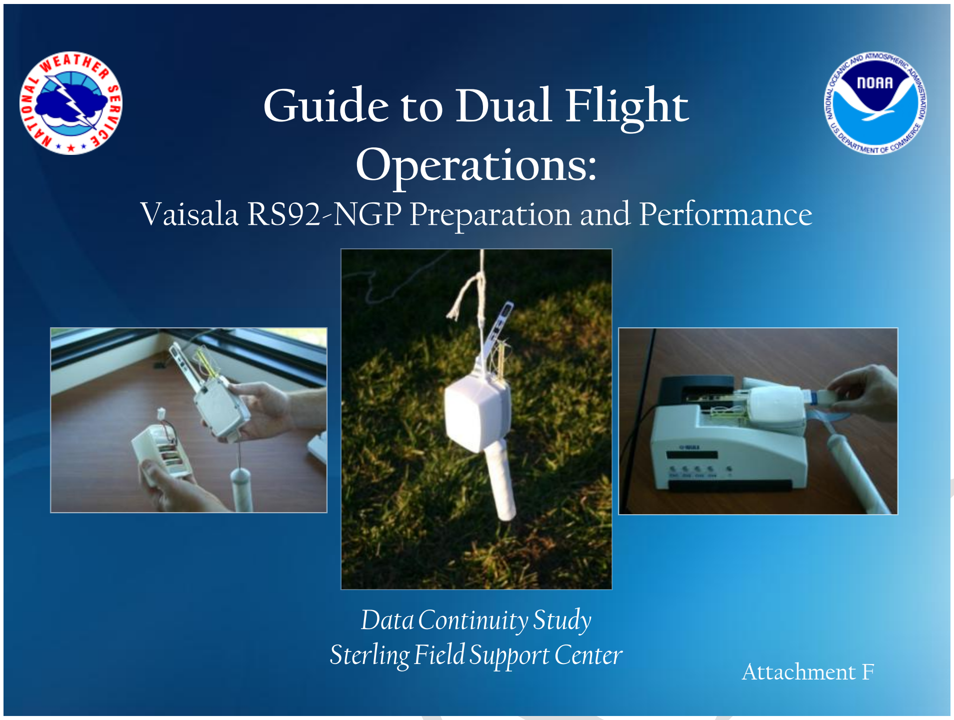
Excluding Holidays

Contact

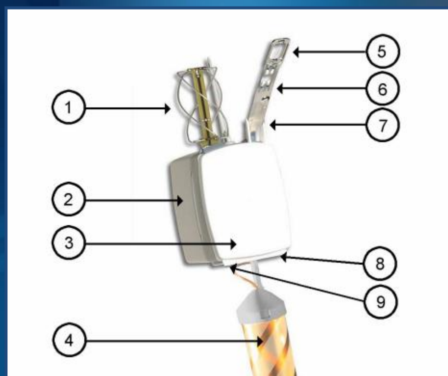
(703) 661-1268

(703) 661-1293

ATTACHMENT F: Guide to Dual Flight Operations: Vaisala RS92-NGP Preparation and Performance



Vaisala RS92-NGP



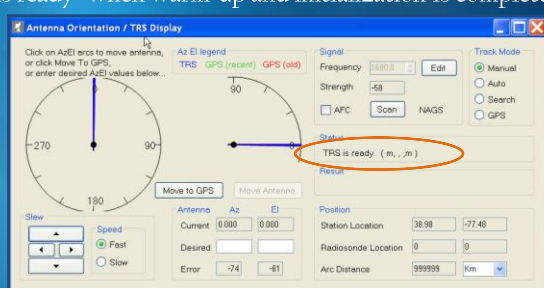
- 1 = GPS Antenna
- 2 = Battery Housing
- 3 = Vaisala Radiosonde RS92-NGP
- 4 = Antenna, mailing bag inside
- 5 = Temperature Sensor
- 6 = Humidity Sensor
- 7 = Sensor Boom
- 8 = FSD25 Interface
- 9 = Additional Sensor Interface

Total Weight of Vaisala RS92-NGP: 305 grams

3

RRS System Initialization

- Start RWS and allow TRS to warm-up
  - Allow at least 30 minutes prior to baseline
    - TRS Warm-up is dependent on ambient temperatures, but generally lasts between **10-30 minutes**
    - Initialization takes approximately **1 minute**
    - SPS requires ~**15 minutes** to establish the GPS almanac
  - The TRS Status Line on the Antenna Orientation Display will indicate "TRS is ready" when warm-up and initialization is complete



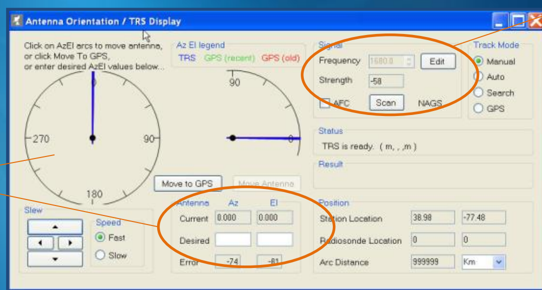
4

RRS System Initialization

- Prepare the TRS for baseline
  - Orientate the TRS Azimuth and Elevation towards the baseline location
  - Tune the TRS to the desired radiosonde frequency

Setting the frequency

Orientating TRS Azimuth and Elevation



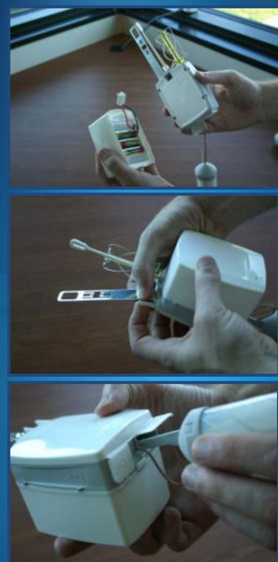
5

Radiosonde Preparation and Handling

- Carefully unpack the radiosonde and inspect for damage
- Record Serial Numbers
- Place on the Frequency Setting Device (FSD) to set the frequency and burn off contaminants
  - Plug connector into radiosonde
  - Turn on FSD power
  - Select frequency channel

CH1= 1676 MHz CH2= 1678 MHz
CH3= 1680 MHz CH4=1682 MHZ

Radiosonde Preparation and Handling



- Plug in the battery connector and attach the battery pack
  - A click will indicate the radiosonde edges are sealed
- Carefully clip the sensor boom into place
- Plug in the transmitter into the bottom of the radiosonde between the FSD25 and Additional Sensor Interfaces
- Note the lifting device

7

Baselining and GPS Lock

- Prior to Baselining
  - Ensure the TRS is orientated to the baseline position, tuned to the correct frequency, and that the AFC is ON
- Baseline Position
  - Radiosonde should be placed on a radiosonde stand or suspended from above
  - Do not place radiosonde on a solid surface as this may result in poor performance
  - Place under or near the GPS repeater (repeater must be powered on)
  - Observer MUST wait at least **5 minutes** before accepting baseline. Time is needed for the sensors to stabilize and for a proper sensor correction to be calculated
    - *Failure to do so will result in a required termination*
- A minimum of 4 satellite matches are required for GPS lock

8

Baselining and GPS Lock

Vaisala RS92-NGP on Radiosonde Stand

Vaisala RS92-NGP suspended from above

9

Baselining and GPS Lock

- If there is no GPS during baseline (Ref: RRS User's Guide)
  - Verify Signal Strength and Antenna Position
  - Verify that the correct amount of time has passed
  - Reset the radiosonde
    - Carefully open the plastic casing and disconnect the battery
  - Reset the SPS via the Hardware Manager Status Display
  - Reset the UPS power via the Hardware Manager Status Display
    - This may require the TRS to warm-up and complete initialization processes again

*Allow at least **15 minutes** for GPS almanac to rebuild after performing an UPS or SPS reset*

- If the pressure discrepancy is within ±3 hPa, accept baseline
  - "Waiting for Release" will then be displayed on the RWS screen

10

Baselining and GPS Lock

- For additional information and assistance
  - FAQs Website
    - http://ops13web.nws.noaa.gov/rrd/
  - RRS Helpline
    - (703) 661-1268

11

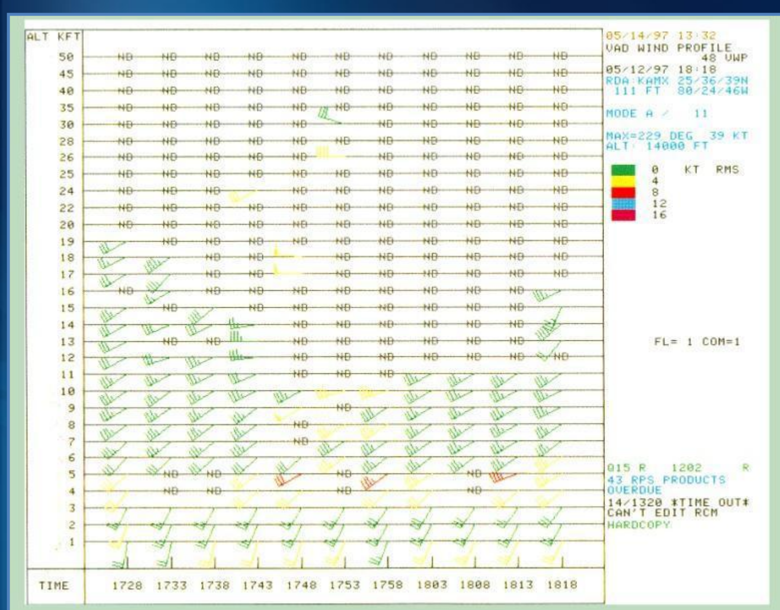
Take a Break..

12

Launching the Radiosonde

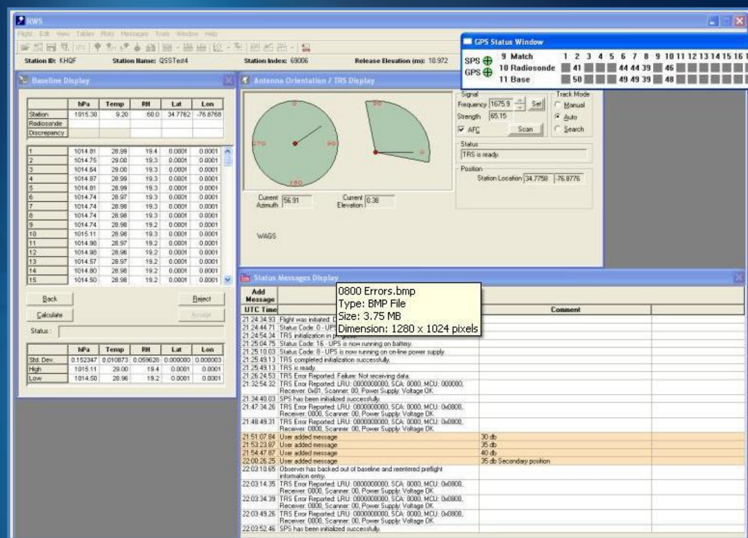
- Position the TRS before proceeding to the release site
  - Manual Track Mode
  - Direct Azimuth and Elevation to where the radiosonde is expected to travel (downwind)
- After release, utilize the remote Control Display Unit (CDU) to track the radiosonde
  - Wide Angle Gathering System (100 °)
  - Narrow Angle Gathering System (15 °)

13



14

0x0800 Errors



15

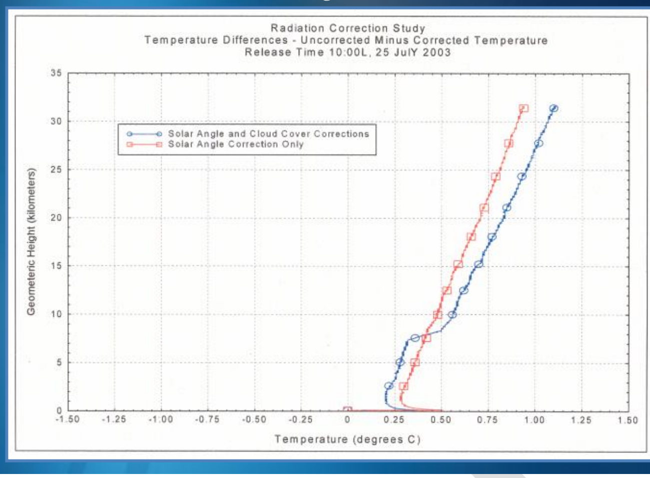
Quality Control After Release

- Ensure the TRS is tracking appropriately and that signal strength is acceptable
  - Place the Antenna into the Move to GPS mode <u>only if</u> GPS is available
    - Selecting Move to GPS when GPS is not available may cause the software to freeze
  - Monitor the Status Messages for any tracking notifications
- Update the Surface Observation and release time as necessary
  - For release time, check the first pressure data point below the red line in the Received PTU Tabular Display
    - Should have a pressure less than or equal to the release pressure shown in the Surface Observation
  - Check the Geopotential Height and ensure it increases with time
  - Verify the Cloud/Weather observation and ensure it's accurate at release

16

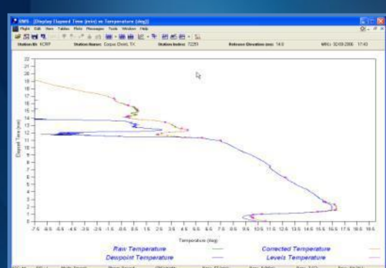
Temperature Correction

- Temperature correction added to raw temperature
  - Red is the correction for the solar angle with no clouds
  - Blue is the correction for the solar angle with a cloud deck at 8 km



17

Quality Control After Release



Wet-bulb Effect

Noisy RH Data

- Marking & Editing Data
  - Verify data continuity from the surface into flight
    - Dry RH bias just off the surface
  - Common data quality problems requiring attention
    - "Wet-bulb effect"
    - Noisy RH data
    - Super-adiabatic lapse rates
  - During flight, periodically check for anomalous data
    - Plots
    - Check Messages

18

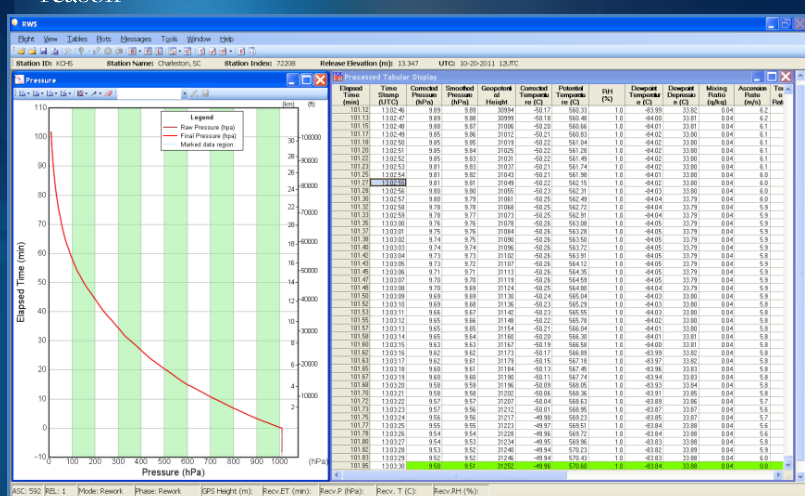
Editing Coded Messages

- Once the Coded Messages are generated, review plots, Check Messages and Tabular data prior to transmission
  - If changes to the flight data are made, Coded Messages will need to be recoded
    - Edits made in the Processed Tabular Display
- Do not edit the body of the Coded Messages unless absolutely necessary
  - Necessary edits include:
    - Adding appropriate 101 groups
    - Adding appropriate Icing comments to RADAT
  - Editing the message body will not affect the processed data
  - Edits to the message body are not saved to the NCDC Archive file

19

Quality Control After Release

- When the flight has terminated, verify termination time and reason



20

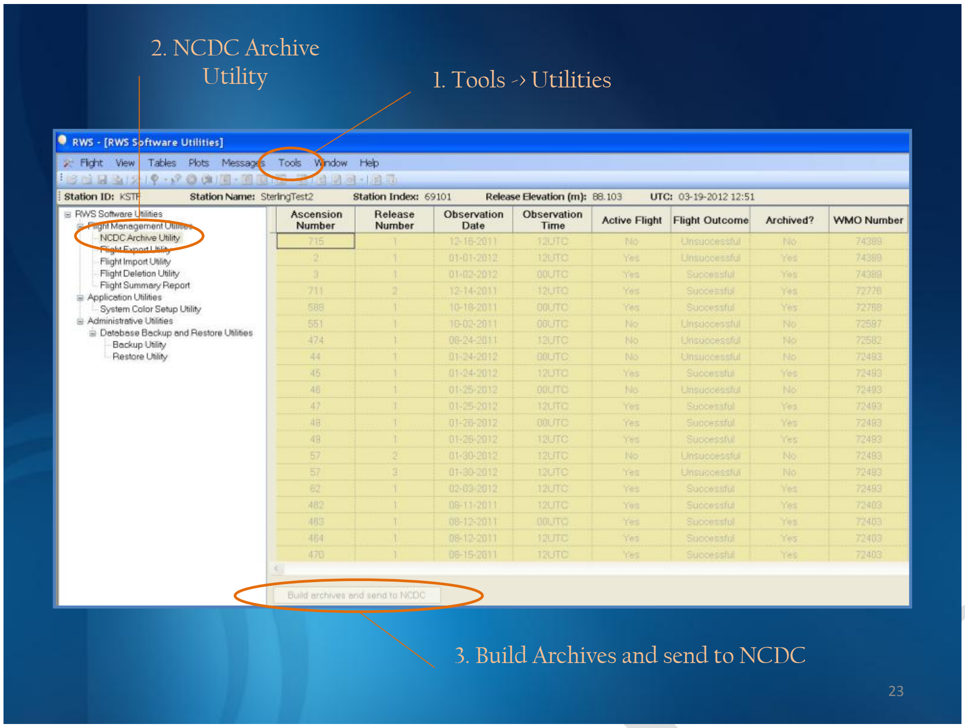
Take a Break..

21

Transmitting an Archived Flight

- In Utilities, select NCDC Archive Utilities
  - Select the flight to Archive
  - Select “Build Archives and send to NCDC”
  - Individual log files for each office can be found here:
    - www1.ncdc.noaa.gov/pub/data/ua/RRS/2008/

22



RWS Capture Program

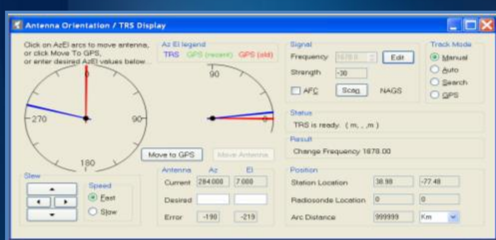
- Captures the flight data and associated logs
  - Sends flight data and logs to WSH
    - Software and RRS performance analysis
  - First 30 days
    - Run Capture after each flight
  - After the first 30 days
    - Run Capture for flights that have problems or pose concerns
- Select icon located on the desktop
  - Select the most recent release & ascension number from a pull down menu
  - Click Capture
  - Flight data and logs are then sent to WSH

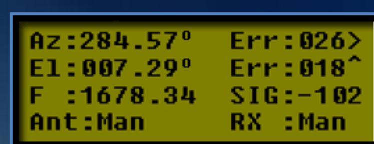
24

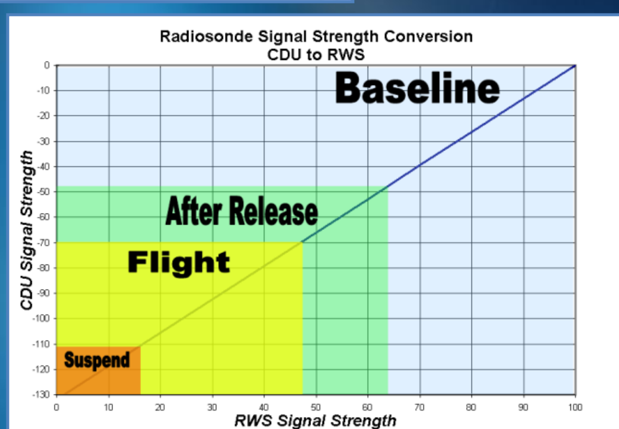
Controlling the TRS Antenna

Remote Control Display Unit (RCDU)

25







26

Second and Third Releases

- Leave UPS(TRS) ON after the first release
- Place the TRS in Manual
- Set the new radiosonde to a different frequency
- Set the TRS to the new frequency
  - Don't Scan as this could cause the TRS to lock onto the previous radiosonde
- Move TRS back to the baseline position
- After a successful flight, select the active release to Archive

27

NWS Sterling Field Support Center
RRS Helpline

- The RRS Helpline does not supersede your local or regional policies, procedures or regulations.
- Problems identified to be outside of the scope of the RRS Helpline will be escalated to the appropriate personnel.
- Issues affecting successful launches take priority.

Hours of Operation

M-F

10:00-02:00 UTC

No Holidays

Contact

(703) 661-1268

(703) 661-1293

GPS SITE SURVEYING STANDARD OPERATING PROCEDURE MANUAL

Attachment G

Prepared by
Sterling Field Support Center

Updated April 6, 2012

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

GPS SURVEYING DRAFT

Procedure for Survey of TRS/ART Location, Radiosonde Release Location, SPS GPS Antenna Location, and PDB location.

It is recommended that the system not be placed in any hazardous type of weather (i.e. heavy rain, snow, etc). Although the system is to a degree "waterproof", it is not recommended for fear of water finding a way into the GPS receiver. Also recommend the unit not be used in conditions where temperatures are within -40°C<X<65°C.

<u>SETTING UP THE GPS RECEIVER</u>

The GPS Receiver, in its default setting, will automatically receive data in a "Static" form. This is the type of data needed for this process. There should be no need to have to set up the receiver in any way for our GPS surveying process. If for some reason you need or want to set up the receiver in a manner that is not of the default variety (i.e. kinematic data transmission, timed surveying, etc), the enclosed GPS 5700 manual will direct and walk you through the process.

<u>SETTING UP THE TRIPOD, GPS RECEIVER, ZEPHYR, AND ASSOCIATED CABLES</u>

This section has two sets of directions: One set will be for setting up the unit in a radome without a TRS or for any random survey point, and another set will be for a unit that has a TRS. If you are taking a GPS survey point for the RSOIS, set up under the temperature sensor.

WITHOUT A TRS OR FOR A GENERAL SURVEY POINT:

1) Clear the radome of all old radiosonde equipment. Mark the TRS mounting points on the floor of the radome. Mark the center point between the TRS mounting points.
2) Set up the GPS antenna tripod over the center point of the TRS footprint. The center pole point should be placed directly on the center point of the TRS footprint. Extend the three legs so that the tripod is approximately level. Using the spring-loaded adjustment levers on two of the legs, level the tripod accordingly. The bubble level mounted on the tripod will give you a fairly approximate level reading.

Figure 42. GPS Antenna Tripod

3) Once the tripod is level, verify the point on the end of the center pole is still setting on the center mark of the TRS footprint. (Even the slightest nudges can knock the tripod out of level, make sure to check it after every step)
4) Mount the GPS antenna on the tripod and orient the north arrow on the GPS antenna (Zephyr) to agree with the compass on the tripod. The north arrow can be found on the underneath side of the Zephyr labeled with a diagram and at position number 1.
5) Measure the height from the indented line that rims the Zephyr down to the radome floor. This measurement should be made in meters, and be measured to an accuracy of 0.001 m. Note this measurement.
6) Hang up the yellow Trimble GPS receiver onto the red knob and associated velcro strip. Make sure to once again check the level bubble. (**Proceed to Powering on and Collecting Data)**

Figure 43. Trimble GPS Receiver on GPS Antenna Tripod

WITH A TRS:

1) Make sure the TRS/UPS is turned off.
2) Gently pull down on the dish of the TRS so that you can reach the NAGS. Make sure the NAGS is facing as close to due North 0° as possible.
3) Unscrew 4 NAGS screws to allow the NAGS flush-mount plate to be placed on the end of the NAGS. Screw on with 4 given screws.

Figure 44. NAGS flush-mount plate on NAGS end

4) You can now place and screw on the Zephyr Antenna on to the threaded end of the bolt. Make sure the number 1 arrow on the bottom of the antenna (also note the Trimble sticker designating the area) is facing straight down. When the dish is in the upright position, this will have the antenna facing due north.
5) Using the yellow GPS cable, connect one end (straight end) to the GPS port on top of the yellow Trimble GPS receive. The other GPS connection (right angle) should screw on to the bottom of the Zephyr.
6) ** This step is only if you are not using the internal batteries given**. Connect the external power cable to the external power port (either port 2 or port 3) by matching up the red dots on the port and the cable end. Do not force them together as this may cause the pins to bend.
7) ** This step is only if you are not using the internal batteries given**. Connect the external power cable to a power cord, and plug the power cord into an associated outlet.
8) You are now ready to power on and collect data.

POWERING ON AND COLLECTING DATA

1) Make sure you have the correct settings (if needed) for the GPS Receiver. The default settings are the correct settings unless otherwise noted.

2) To turn on, press the green power button on the front of the receiver. A green light should light up on either 2 or 3, depending which port you have the power cord plugged in to, or whichever battery is currently running.
3) Once your green light is on, look to the left part of the panel to see if there is a blinking light under the GPS mark (red light). Once this light goes from fast blink to slow blink, you can now press the blue button (data button). An orange light will appear signifying data is now collecting.
4) Allow the receiver to stream data for approximately 4 hours.
5) When the allotted time is up, hold the power button down for two seconds, you should see all of the lights turn off. This will turn the power off. You can now disconnect, and disassemble the GPS unit.

<u>TRANSFERING DATA FROM RECEIVER TO COMPUTER</u>

1) Plug the power cord into an outlet, the cable connection to Port 2 of the receiver, and the comp port into the back of the computer. Now hook up the USB cord from the bottom of the GPS receiver (there is a latch at the bottom of the receiver that opens up) to the computer. The receiver is now hooked up to the computer.
2) Select All Programs, Trimble Data Transfer, Data Transfer (A data transfer window will appear)
3) Make sure the drop down box on the top left under 'Device' says "GPS Recvr-5000 Series: COM 1". You should see on the top right a green check mark stating the device is connected to the computer.

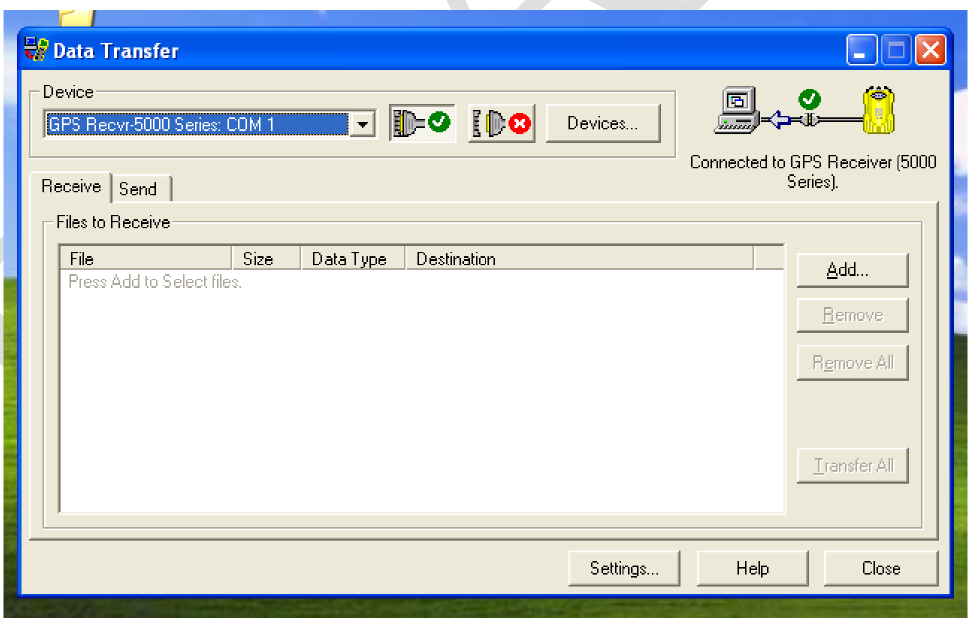


Figure 45. Data Transfer Window

4) Click on the 'Add' button which will bring up an Open Window. In that open window select the Yellow Icon that says 5700-xxxxxxxx
5) You should now be able to select the latest GPS data file. Open this file.

6) After clicking 'open' you should now be back to the Data Transfer Window along with the file attached. You can now click 'Transfer All'. Once the file has transferred you will have a Transferred Completed box appear. Click close.
7) Two files have now been created: a .dat and a .T00 file. They are both placed in the GPS DATA file on the desk top.

SENDING DATA TO OPUS

1) Open up IE and go to the website: http://www.ngs.noaa.gov/OPUS/index.jsp
2) Click on the box on the right that says: NAD 83 (CORS96, MARP00, PACP00) epoch 2002.00 ITRF00
3) Enter your email address.
4) For the data file, enter the .dat file (this file will show up in the GPS folder as the one that's not .T00)
5) The antenna type is: TRM41249.00 SCIT Zephyr 4-Point feed antenna –Stealth Group
6) Enter the distance (in meters) that you measured outside from the base of your point to the line in the Zephyr. ***If you are inside a radome make sure you run opus 2 times. First time you will enter 0 for your height. This will give you an approximate 1 meter difference from the GPS egg to the end of your antenna. Add .9 meters to the meta-data table. The second time you enter the data in OPUS, enter 1.22 as your (m) height. This is a correction factor for launch height. The delta between your two OPUS solutions should be roughly 2m.
7) Click Options and make sure the Geoid Model is Geoid 09
8) Click on "Upload to Static"
9) An email should be sent to you within 15 minutes with an attachment giving you your ortho height and lat/lon's

FINDING HEIGHT/DISTANCE USING LINE OF SIGHT FOR SURFACE EQUIPMENT

This section will allow you to determine an objects height once you determine a base height, for instance the surface release point. Once that height has been determined, you will be able to use this procedure to accurately determine the height of surface instruments (i.e. RSOIS) or any other object for that matter. You will also be able to determine distance away from a reference point, along with the angle at which it is located. For these surveys, we will use the release point as our reference point. This procedure usually takes two people.

1) For this type of survey we will use the release point as our reference point. However, you can certainly use this method to create your own reference point, site dependent. Configure the tripod as you normally would for a GPS survey. However, this time you will only need to screw on the Optical Survey unit. Make sure the unit is level, on the tripod and the Optical unit.
2) Once the entire unit is level, rotate the Optical unit 180º, making sure the entire unit is still level. If it is not, follow the instructions in the handbook which should be located in

the Optical unit’s box. These directions will show you how you are to readjust the unit to calibrate it.

3) Measure the height from the ground to the middle of the optical lens and write down that value in inches.
4) Have the other person hold the meter extendable ruler on the ground (vertically) of the location you want to survey and use the optical unit to zoom in on the numbers.
5) Once you focus on the numbers, look for the number that falls into the center cross-hairs. If that number is lower than the value of your height that you wrote down earlier, than the position you are measuring (area where ruler is at) is higher than your location, and vice versa.
6) Use the top cross hair and the bottom cross hair to determine the distance in feet you are away from the ruler. Take the top cross hair and minus the bottom cross hair. Take that value and times it by 100. (If top was 30” and bottom was 28”: 30”-28”= 2 x 100= 20 feet.
7) If you’re attempting to use a reference point from inside, a laser level is available to shoot a laser outside to a point, usually on the ruler. That point can be used to do your measurements.

ATTACHMENT H: Official Site Metadata Information Template

Official Site Metadata Information

Surface Observing Instrumentation (RSOIS)
Radiosonde Replacement System (RRS)
MicroART

Attachment H

Prepared by
Sterling Field Support Center

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service/Office of Operational Systems
Field Systems Operations Center/Observing Systems Branch

Introduction

SITE SPECIFIC DATA FOR: Weather Forecast Office	
Date(s) Recorded:	
Survey Team:	

Resident Site Specific Data: – RSOIS Site **Position information was determined using a Trimble GPS receiver model 5700. Estimated position error less than**	
Site Commentary	
Station Name	
Station Latitude (dd:mm:ss.sssss)	
Station Longitude (ddd:mm:ss.sssss)	
Station Elevation (MSL)	
WMO No	
WMO Region	
Station ID	
Time Zone	
Surface Observation Equipment Type	
Distance from Release Point (m)	
Surface Observation Equipment Elevation (msl)	
Surface Observation Equipment Bearing (Deg)	
Temperature Sensor	
Elevation (AGL)	
Orientation (Bearing)	
Manufacturer	
Model	
Type	
Calibration Date	
Relative Humidity Sensor	
Elevation (AGL)	
Orientation (Bearing)	
Manufacturer	
Model	
Type	
Calibration Date	
Wind Sensor	
Elevation (AGL)	
Orientation (Bearing)	
Manufacturer	
Model	
Type	
Calibration Date	

Barometer	
Elevation (MSL)	
Elevation (AGL)	
Orientation (Bearing)	
Manufacturer	
Model	
Type	
Calibration Date	

Figure 46. RSOIS Tower looking Northwest

Figure 47. Looking North from base of RSOIS Tower

Figure 48. Looking East from base of RSOIS Tower

Figure 49. Looking South from base of RSOIS Tower

Figure 50. Looking West from base of RSOIS Tower

SITE SPECIFIC DATA FOR: Weather Forecast Office
Date(s) Recorded:
Survey Team:

Resident Site Specific Data: Office – RRS **Position information was determined using a Trimble GPS receiver model 5700. Estimated position error less than**	
Site Commentary	
Station Name	
Station Latitude (dd:mm:ss.sssss)	
Station Longitude (ddd:mm:ss.sssss)	
Station Elevation (MSL)	
WMO No	
WMO Region	
Station ID	
Time Zone	
WBAN	
WSFO ID	
AWIPS XXX (FAA) ID	
Base Pressure (hPa)	
Release Point Latitude (dd:mm:ss.sssss)	
Release Point Longitude (ddd:mm:ss.sssss)	
Release Point Elevation (MSL)	
Release Point Pressure Correction (hPa)	
Basestation GPS Elevation (WGS84)	
Basestation GPS Elevation (MSL)	
Basestation GPS Latitude (N+/S- ddmmss.fffff)	
Basestation GPS Longitude (E+/W- dddmmss.fffff)	
TRS Elevation (m)	
TRS Latitude (N+/S- ddmmss.s)	
TRS Longitude (E+/W- dddmmss.s)	
Orientation Correction Azimuth Angle (Deg)	
Orientation Correction Elevation Angle (Deg)	
Surface Observation Equipment Type	
Distance from Release Point (m)	
Surface Observation Equipment Elevation (MSL)	
Surface Observation Equipment Bearing (Deg)	
Radiosonde Type	
Ground Receiving System	
Ground Receiving System Serial Number	
Radiosonde Tracking Method	

Barometer Height (MSL)	
Balloon Shelter Type	
Balloon Gas	
Operating Frequencies (MHz)	
Rooftop Release	
WMO Header (FZL)	
WMO Header (MAN)	
WMO Header (SGL)	
WMO Header (ABV)	
WMO Header (ULG)	
WMO Header (DD1)	
WMO Header (DD2)	
RRS Application Offline Maintenance Site Specific Data	
RRS Station ID (Kxxx)	
TRS Position Latitude (ddmmss.x)	
TRS Position Longitude (dddmmss.x)	
TRS Elevation (m)	
TRS Bearing to Baseline area - AZ	
TRS Bearing to Baseline area - El	
TRS Bearing to Release area - AZ	
TRS Bearing to Release area - El	
RWS Site Specific Data	
RWS IP Address	
RWS Computer Name	
Default Gateway	
Subnet Mask	
Preferred DNS Server	
Alternate DNS Server	
Primary AWIPS Data Type	
Primary AWIPS Data Phone No.	
Primary AWIPS Data Server IP	
Primary AWIPS User Name	
Back Up 1 AWIPS Data Type	
Back Up 1 AWIPS Data Phone No.	
Back Up 1 AWIPS Data Server IP	
Back Up 1 AWIPS User Name	
Back Up 2 AWIPS Data Type	
Back Up 2 AWIPS Data Phone No.	
Back Up 2 AWIPS Data Server IP	
Back Up 2 AWIPS User Name	
Back Up 3 AWIPS Data Type	
Back Up 3 AWIPS Data Phone No.	
Back Up 3 AWIPS Data Server IP	
Back Up 3 AWIPS User Name	

GPS Repeater Site Specific Data	
GPS Repeater Amplifier Gain Setting	
TRS Adjustable Coefficients	
cc@0	
cc@1	
ccv	
cci	
cm@0	
cm@1	
cmv	
aai	
aei	
cs@0	
cr@0	
cr@1	
cr@2	
cr@3	
crv	
cris	
crqs	
crqo	
crcd	
crc0	
crqd	
crqc	
crqr	
crd	
cro	
crlo1	
crlo2	
crlo3	
cl@0	
cl@1	
clbv	
clbf	
clv	
cl1	
c2@0	
c2@1	
c2bv	
c2bf	
c2v	
c2l	
TRS Site Specific Coefficients	

ccsf	
ccsq	
ccsa	
ccse	
cma	
cmu	
cmn	
cmoa	
cmoe	
cmia	
TRS Special Coefficients for Scanner/LNA Modifications	
crqw	
crql	

Figure 51. Looking North from designed release area

Figure 52. Looking East from designed release area

Figure 53. Looking South from release area

Figure 54. Looking West from release area

SITE SPECIFIC DATA FOR: Weather Forecast Office	
Date(s) Recorded:	
Survey Team:	

Resident Site Specific Data: –MicroART
Position information was determined using a Trimble GPS receiver model 5700. Estimated position error less than

Site Commentary

Station Name	
Station Latitude (dd:mm:ss.sssss)	
Station Longitude (ddd:mm:ss.sssss)	
Station Elevation (msl)	
WMO No	
WMO Region	
Station ID	
Time Zone	
WBAN	
Base Pressure (hPa)	
Release Point Latitude (dd:mm:ss.sssss)	
Release Point Longitude (ddd:mm:ss.sssss)	
Release Point Elevation (msl)	
Release Point Pressure Correction (hPa)	
Target Antenna Azimuth Angle (deg)	
Target Antenna Elevation Angle (deg)	
MicroART Elevation (m)	
MicroART Latitude (N+/S- ddmmss.s)	
MicroART Longitude (E+/W- dddmmss.s)	
Orientation Correction Azimuth Angle (Deg)	
Orientation Correction Elevation Angle (Deg)	
Surface Observation Equipment Type	
Distance from Release Point (m)	
Surface Observation Equipment Elevation (MSL)	
Surface Observation Equipment Bearing (Deg)	
Radiosonde Type	
Ground Receiving System	
Radiosonde Tracking Method	
Barometer Height (MSL)	
Balloon Shelter Type	
Balloon Gas	
Operating Frequencies (MHz)	
Rooftop Release	
WMO Header (FZL)	

WMO Header (MAN)	
WMO Header (SGL)	
WMO Header (ABV)	
WMO Header (ULG)	
WMO Header (DD1)	
WMO Header (DD2)	
Host Computer	

Figure 55. Looking North from base of elevated MicroART system

Figure 56. Looking East from base of elevated MicroART system

Figure 57. Looking South from base of elevated MicroART system

Figure 58. Looking West from base of elevated MicroART system

ATTACHMENT I: Radiosonde Test Stand (RTS) Installation Instructions